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MACHINERY

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CONTENTS OF THIS NUMBER

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FOREIGN MACHINERY MERCHANTS PAGES, 452-453 ADVERTISERS INDEX, 483-484 PRODUCT INDEX, 454-480

The Editor's Monthly Talk

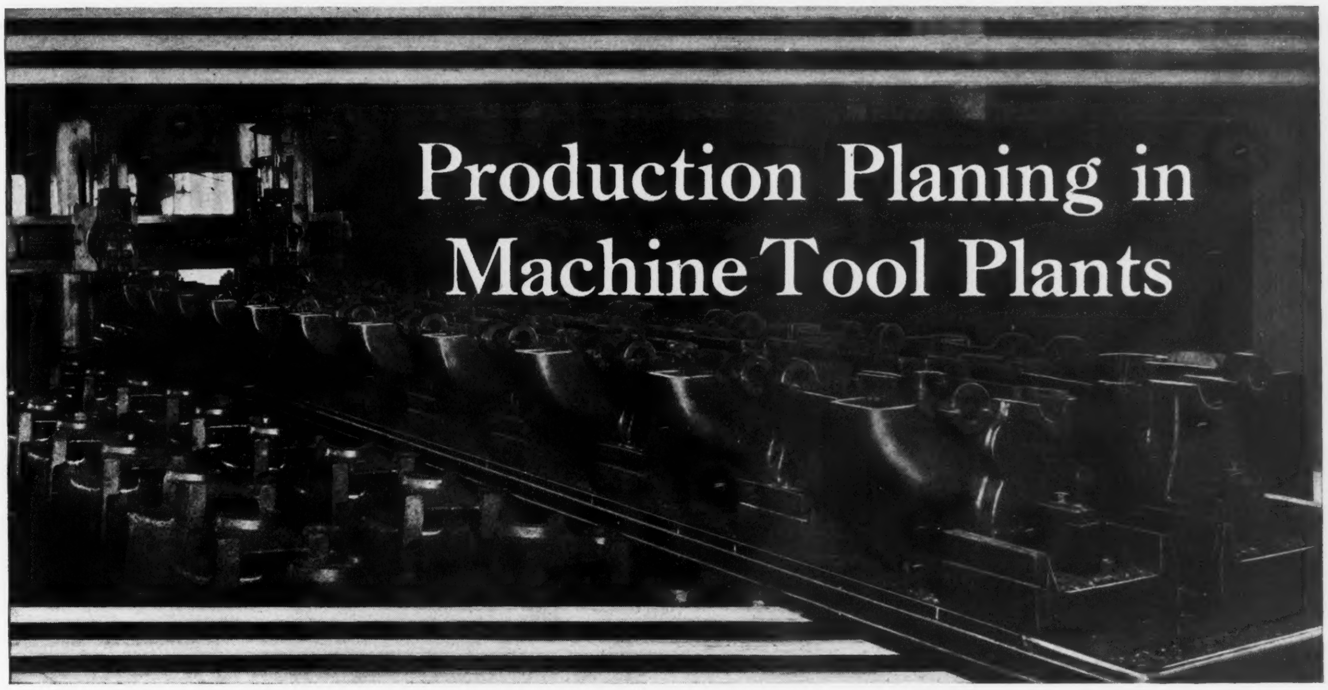
AT the threshold of a new year we instinctively review the past and forecast the future. MACHINERY looks back upon twelve months filled with endeavor to give its readers the best service possible, during which there were published 1188 pages of editorial and contributed matter, comprising 979 separate articles and items of information, not counting the regular news features such as personals, manufacturers' notes, etc. Of the articles published, 107 were devoted to general machine shop practice and methods used in up-to-date manufacturing plants—in all 481 pages. The design of machinery and machine details was dealt with in 62 articles, of 178 pages; shop and drafting-room systems and management in 38 articles of 72 pages; and foreign and domestic trade in 43 articles of 65 pages. In the New Machinery and Tools Section, 259 new or improved machine tools and devices were illustrated and described. There were 115 Practical Letters from MACHINERY's readers—one of the most valuable features, and 17 pages of How and Why questions and answers dealing with practical problems arising in shop and drafting-room, mostly involving shop mathematics. There were 2023 illustrations using 1111 halftones and 912 line engravings.

Statistics may be dry reading, but often they enable us to see things adequately. The mine of practical information MACHINERY collects and publishes in a year involves an enormous amount of work and an outlay which few readers can appraise.

During the past year developments in automotive shop practice have been more rapid than in any other field. These have been recorded by MACHINERY in many recent articles. The very live subject of industrial relations has received adequate attention in the definite manner characteristic of MACHINERY—neither too conservative nor too radical—the aim being always to present facts rather than theories, results rather than expectations. The whole field of machine shop practice has been closely and systematically searched for new and improved methods and practices, for MACHINERY knows where to look and is always on the job. The same is true of foreign and domestic trade in machine tools—our correspondents cover all important markets.

During 1921 MACHINERY will still further extend its service to readers and advertisers. In this, the January number, begins an important series on production planing, and on shaper and slotter practice. Early issues of the year will contain important articles relating to applied interchangeable manufacturing practice, production control, piece work and bonus systems, grinding practice, sand-blasting, drafting-room methods, and scores of other subjects equally important to managers and superintendents, engineers and designers, foremen and others responsible for results in machine-building shops. Every phase of shop practice and management will receive adequate attention.

Important developments are taking place in the machine shop field as we enter upon the new year. Some machines and devices have recently been brought out that will prove almost revolutionary in their effect upon productive capacity and accuracy in machine work. Production especially was striven for in the developments of the past twelve months. These advances in practice and design are not confined to any one line of machine tools, although they have been more pronounced probably in the automatic, the milling machine, and the grinding machine field; but none of the other fields should really be omitted, for marked advance has been made in all. For example, in rapid production drilling, records have been made during the past year that completely eclipse previous performances. Great progress has been made in the development of recording and controlling apparatus for the heat-treatment of steel. A considerable advance has been made in the art of cutting and testing gears—in fact there has been marked progress in many different lines. Should each succeeding year mark advances in machine shop practice as important and valuable as those recorded at the end of 1920, the next decade will see so great a development in the productivity of machine tools that even the most optimistic could hardly visualize the vast economies and benefits to be realized. In the general field of applied science, also, remarkable advances have been made, and the new decade beginning on January 1, 1921, devoted as we hope it will be to peace and reconstruction, is likely to be a period of great forward steps in the fields of engineering and science.



Production Planing in Machine Tool Plants

Planer Practice in a Number of Plants Building Milling Machines—First of a Series of Articles

By EDWARD K. HAMMOND

TEN years ago, one frequently heard men of experience in machine shop practice express the belief that planers were destined to be superseded by other types of machines; but that this opinion was unjustified is evidenced by the fact that planers still retain their position as an indispensable part of the equipment of machine shops engaged in handling many classes of work. As their name implies, planers are used chiefly for machining flat surfaces on small, medium, or large sized pieces of work. Although it is impracticable to lay down any general rule governing the order in which machining operations should be performed, it is quite a general practice to send rough castings or forgings to the planer department for the first operation, and the surface so finished is then utilized as a locating surface in setting up the work for subsequent operations that are handled on planers or on other types of machines. Planing is successfully employed for finishing horizontal, vertical, or inclined flat surfaces; and where suitable provision has been made, it is possible to machine convex or concave curved surfaces of cylindrical or irregular form.

A list of the customers of any builder of planers doing an extensive business will reveal the fact that machines of this type are used in a great variety of industries, and with this point in mind, it is not surprising that the requirements that must be fulfilled in planing operations also extend over widely divergent limits. At one extreme there is the case where a large bed casting for a machine is planed on its base in order to produce a satisfactory foundation. Obviously, such a job does not call for any considerable degree of accuracy, it being merely required to remove the excess metal and leave the bottom of the work practically flat. Frequently, such jobs are performed by simply taking a roughing cut, using as high a speed and heavy a feed as the cutting tools are capable of standing.

From this extreme, the range of the planer extends all of the way up to operations where a high degree of precision is required. On planed work, dimensions are often held within 0.0005 inch or even closer to the specified size. Examples of this kind are found in machine tool building plants in the finishing of flat bearing surfaces, etc., where it is required to have the planed surfaces perfectly flat and straight, and also to have them so located in relation to other fixed points on the work that the fits of such sliding members as milling machine knees and tables, or knees and columns, will enable them to run smoothly in contact with each other,

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General statements may prove misleading; however, it is fairly safe to say that, judging from average practice, planers are operated at a lower rate of efficiency than many other types of machine shop equipment. This condition is due to the failure of many planer-hands to understand the best methods of performing planing operations. A survey of the fields in which planers are used reveals the fact that probably there is no other industry where machines of this type are producing more efficient results than in the building of machine tools. Recognizing this fact, a careful study has been made of the most approved methods of handling work on planers used in shops engaged in building the different standard types of machine tools. And as these methods involve the use of principles that are quite generally applicable, it will be evident that the information that has been selected for these articles should also prove of practical value to men in many lines of work other than the building of metal-working machinery.

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and without vibration or other undesirable conditions of operation present in a machine where there is any appreciable amount of lost motion between the surfaces of sliding bearings.

Valuable Features of Planers and of Planed Work

There are several important features of planed work which were not generally appreciated at the time when experienced efficiency engineers were predicting that the application of planers would become less extensive, although these points are probably of sufficient importance to have been responsible for the continuation of the use of machines of this type by men who plan the methods of machining that are used in many of the best known American metal-working establishments. Among them, the following are worthy of mention: In fitting sliding bearings, it is often regarded as necessary to perform a final scraping operation, and experience has shown that the planed surface of a good grade of cast iron can be worked more satisfactorily with a scraping tool than is the case with the surface of metal of the same grade, which has been finished by some other method.

In cases where there are a large number of sliding bearings that must be scraped, it will be evident that the finishing of surfaces in a way that enables them to be easily scraped is a matter of no small importance, because many of these planed surfaces are of very considerable size, and it is estimated that under average conditions a scraping tool does not remove more than 0.0002 inch of stock per stroke. This work must be done by hand, and usually calls for considerable judgment on the part of men employed for that purpose. Consequently, the saving effected by performing that part of the work which precedes scraping in a way that reduces the time and labor involved in scraping the surfaces down to a bearing is likely to be far from inconsiderable.

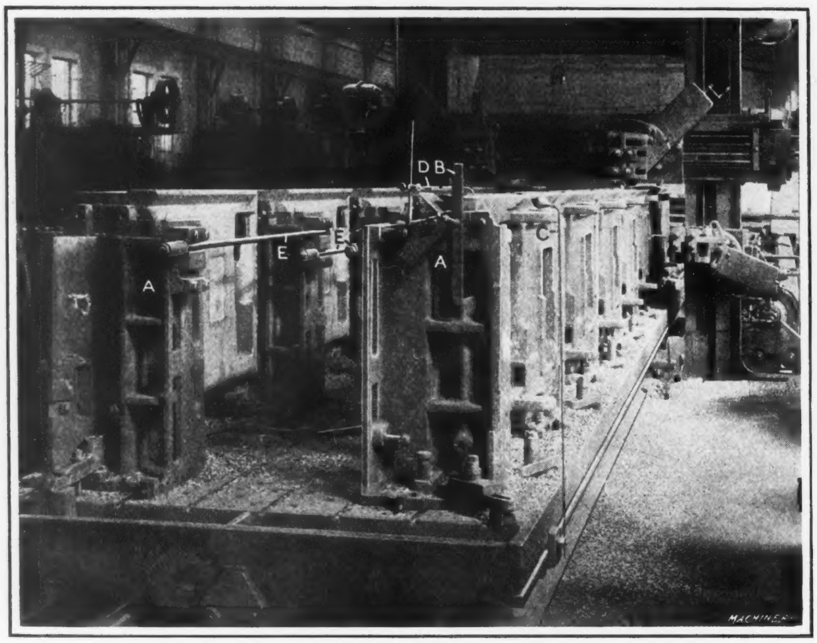


Fig. 1. Machining the Knee Bearing and All Finished Side Faces on Milling Machine Columns

Another important point in maintaining the planer's popularity in metal-working plants is the simple and inexpensive form of the cutting tools that are used. Not only are such tools procurable at a low first cost, but they are also simple to grind, so that the time which must be devoted to this work by skilled tool-room attendants is quite moderate. In this connection, it may be mentioned that the planer may be equipped with various forms of tool-holders or with cutting tools produced by welding high-speed steel or stellite cutter bits to machine steel shanks, and in this way a substantial economy is effected.

Application of Planers in Machine Tool Building Plants

Regardless of the class of work on which planers are used in machine tool building plants, it is probably safe to say that the average methods of planing used in such plants are likely to represent a close approximation of the maximum efficiency. It is for this reason that the major part of this series is devoted to the work of machine tool building plants. However, it must not be thought that the methods here illustrated and described are only applicable for the use of machine tool manufacturers. As a matter of fact, great care has been taken to select for discussion only those methods which have been developed through the employment of principles that are of general application. Consequently, the reader may start upon a study of information here presented for his consideration with the assurance that not only is he going to learn of methods that would be likely to prove useful in handling his work, but that such methods also represent the most advanced practice in this department of machine shop work.

Planing Cincinnati Milling Machine Columns

Where planers are used on repetition production work, rates of output are increased by setting up a number of pieces so that the required operations can be performed on all of them continuously. In a later section of this article, an analysis will be presented of the reasons why such a practice increases the efficiency and accuracy with which the work can be handled. Fig. 1 shows an example of such a planer set up at the plant of the Cincinnati Milling Machine Co., Cincinnati, Ohio, where a 72- by 72-inch planer built by William Sellers & Co., Philadelphia, Pa., has fourteen columns for No. 3 cone type Cincinnati millers set up in two parallel rows on the 40-foot table. This is the first cut taken on these castings, and the operation consists of planing the knee bearing and all finished surfaces on the side of the column to which the feed-box will be attached. Reference to the illustration will make it apparent that the two rows of castings are set up on the planer table with their positions reversed end for end, so that the two heads on the planer cross-rail may be employed for operation on the knee bearings, while the two side-heads can work simultaneously in planing the fit for the feed-box and the other surfaces that have to be machined on this side of the work.

This being the first operation on these castings, it will be evident that care must be taken to set up the work in such a way that the faces to be planed on each piece will be properly located in relation to the outside of the casting and to various other fixed points. The precautions taken to assure attainment of such a result are necessary, owing to both mechanical reasons and to the necessity of producing a good job. In Fig. 1 there are shown several of the tools used in setting up the work, and Fig. 2 illustrates a close-up view of one of the partially planed castings, together with the tools in the rail and side-heads and the gages that are employed for testing the work.

Method of Setting up the Castings for Planing

The method followed in setting up the castings ready for planing is as follows: It will be seen that each casting on the planer table is supported by a fixture *A*. The first step is to secure a wooden stick *B* to the fixture at each end of the row by means of a C-clamp, and then to stretch a string across the row of fixtures between two center marks provided

on the fixtures for that purpose. This string is used as a reference point in setting up all of the castings in their respective fixtures. The purpose of using such a center line is to provide a reference point from which measurements may be made in locating each casting in its fixture, to be sure that the knee bearing on the column will not only be planed in such a manner that it "cleans up" satisfactorily, but to be sure of having this bearing centrally located with reference to the side walls of the casting and with such fixed points as the centers of bearing bosses, etc.

After centering the casting, its position must be adjusted vertically and this is done by the use of a plumb line *C*. It will be obvious that when in use, the plumb-bob will hang at the bottom of the string which is held close to the side wall of the casting, so that an estimate may be made of the amount which it is out of perpendicular and a suitable adjustment of the setting made to compensate for the existence of such an error. In making measurements of the amount of adjustment that is required in both the horizontal and perpendicular directions, use is made of various tools including the height gage shown at *D*.

For planing large castings, and more particularly for handling pieces of work such as those which are at present under discussion, it is necessary to both level up the casting and to provide means for its support when under the pressure of the cutting tools. In the present case, the casting rests on three jack-screws, on which it is centered by making measurements from the string stretched over the row of castings; and then these jack-screws are manipulated to provide for bringing the casting into a vertical position, as indicated by the plumb line *C*. Clamping of each casting in its fixture is accomplished by means of S-shaped straps which extend up from the planer table in such a manner that one end of each strap is resting on the table, while the other end extends through an opening in the work, so that tightening of the clamping bolt results in securing the casting in place.

Other straps of the forms shown in Fig. 1 are used to hold each casting back against its fixture, and jack-screws are placed between adjacent castings of each string to support the pressure of the cutting tools. A large jack-screw is placed inside of each casting to afford support between its walls, and there are small jack-screws located under the projections at the sides of the casting to prevent them from springing under the heavy cuts to be taken. As these pieces were set up on the machine, it was not feasible to take a photograph which would clearly show the method of clamping; but in Fig. 1 there are shown certain features of the arrangement, including some of the straps for clamping the fixtures and work down to the planer table, end stops placed behind the fixtures to support the thrust of the tools, and tie-rods *E* that extend between adjacent fixtures at the top to afford a means of support that will prove effective in eliminating vibration.

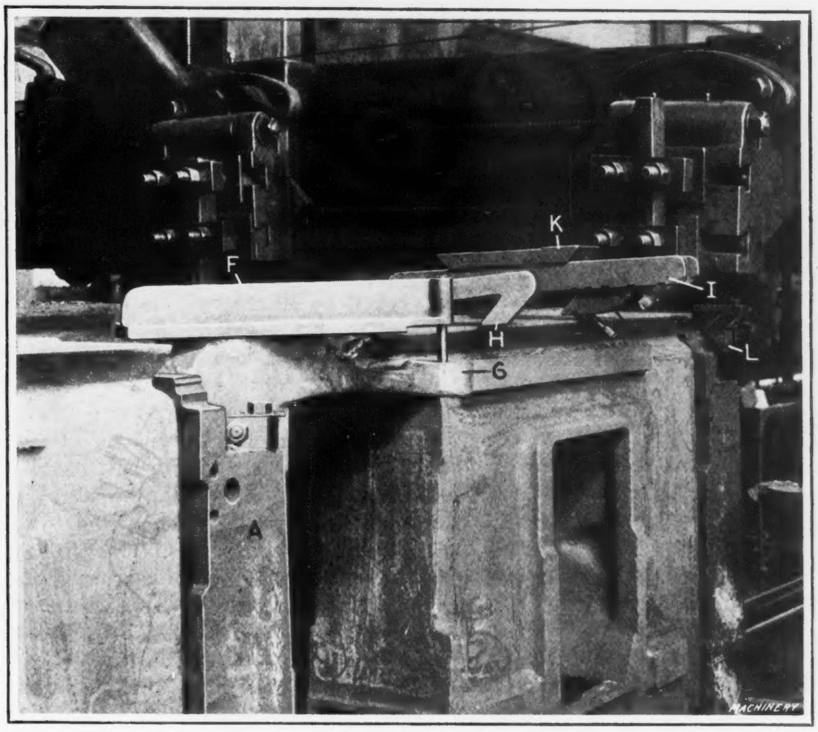


Fig. 2. Close-up View of One Casting, Cutting Tools and Gages for testing Work planed on the Machine illustrated in Fig. 1

Order of Performing the Planing Operations

Mention has already been made of the fact that planing operations performed at this setting comprise the machining of the knee bearing, the seat for the feed-box, the guide for the dog, and the faces of the back-gear arms. Planing of the knee bearings is accomplished with the heads on the cross-rail, one head working on each row of milling machine columns, and the side-heads of the planer are employed for performing all other operations. For taking the roughing cuts, round-nosed tools are employed, and the so-called "straightening out" and finishing cuts are taken with square-nosed spring tools. An important point in connection with the setting of the work and the performing of successive operations is that after the roughing cuts have been completed, the clamps are all released and retightened, care being taken not to apply more pressure than is necessary to hold the work for taking the light straightening out and finishing cuts.

The clamping action provided in this way would not be sufficient to hold the work against the pressure of the heavy roughing cuts; but on the other hand, the clamping effect that is necessary for taking such cuts also produces a certain amount of distortion of the work, and if the finishing cuts were taken with the castings clamped in this manner, releasing of the clamps would allow the castings to spring back sufficiently to far exceed the close limits of tolerance that are allowed in finish-planing. For performing the roughing operation, a cutting speed of 42 feet per minute is employed with a feed of 1/8 inch per minute. For straightening out and finishing horizontal and vertical surfaces, a cutting speed of 27 feet per minute is employed, with a feed of 3/4 inch; and on the angular faces of the dovetail bearings, the same speed is used for the straightening out and finishing cuts, with a feed of 3/8 inch.

Gages Used for Testing the Accuracy of the Work after it has been Planed

In Fig. 2 there are shown gages used for the following purposes: Gage *F* is employed for measuring from the planed face of the knee bearing to the planed face of the back-gear arm *G*. Gage *H* is used for testing the form of the dovetail, tissue paper feelers being employed in connection with this gage so that the form of the dovetail may be ascertained within 0.001 inch. At *I* there is shown a micrometer gage that is employed for testing the distance from face to face of the dovetail knee bearing. This gage is equipped with a micrometer head *J* that may be fitted into various slots in the body of the gage, to provide for using it on different sizes and types of Cincinnati milling machine columns. At the opposite end there is a dovetail bearing integral with the body of the gage, which is hooked over the dovetail; then, the adjustable head *J* is moved up to its slot and the final measurement taken with the micrometer.

Gage *K* is a master used for setting micrometer head *J* for a given size of milling machine column; and after this setting has been made, the micrometer must give the same reading with the gage placed on the planed knee bearing on the work. About 0.002 inch of metal is allowed on each face of the dovetail bearing to provide for scraping it to fit the bearing in the milling machine knee. At *L* there is shown what is known as a tool-setting gage, secured to the back of the work-holding fixture. Where there are a number of horizontal, vertical, and inclined surfaces to be planed on the same piece of work, gages of this type are frequently employed for setting planer tools. The horizontal and vertical faces of the gage constitute reference points against which the tools can be set to finish the work to the required dimensions; and where the planing of angular surfaces makes it necessary to swivel the planer head for that purpose, the tool may be run down the inclined face of the setting gage to make sure that the head has been properly set.

Fig. 3. Open-side Planer equipped for planing Knee Bearings on Columns of Milling Machines

Planing Knee Bearings on Cleveland Milling Machine Columns

In machining the columns of Cleveland millers built by the Clark-Mesker Co. in Cleveland, Ohio, use is made of open-side planers built by the Cleveland Planer Co. Fig. 3 shows a machine set up for the performance of this operation, and the job is of interest because it illustrates the method of setting up and supporting a large casting of this kind. Great care must be taken to provide for resisting both the weight of the work and the pressure of the tools to prevent springing the casting out of shape, which would seriously affect the accuracy of the finished planed surfaces. As the castings come to this machine, they have been faced on the bottom, and this surface is used in locating the work for the performance of the present operation. It will be seen that a strip *A* is placed across the table, with stops *B* to hold it in place. The casting is abutted against this strip and held down by means of straps *C*.

It will be seen that the straps are held by the usual arrangement of bolts entering T-slots in the planer table; and supporting posts are placed under the outer ends of the straps, in a manner that is quite generally employed in planer set-ups. A noteworthy feature of this job is that the planing operation has to be performed on a part of the work that projects out from the base in such a way that it cannot be supported directly from the planer table. Therefore, to give the desired rigidity to the work and to prevent it from springing away from the pressure of the planing tool, it will be seen that two jacks *D* are placed under the forward end, and the supporting action obtained in this way is supplemented by four jacks at the sides of the casting, two of which are shown at *E*, there being two jacks similarly placed at the opposite side of the work. Before the casting is finally clamped for planing, care is taken to level and square it up in a manner similar to that employed in setting up the planer job shown in Figs. 1 and 2; and the knee bearing is then laid off on the column so that it will be properly located in relation to the side walls of the column and to other fixed points on the work.

Fig. 4 shows diagrammatically the sequence of operations performed in the planing of Cleveland miller columns, to bring the knee bearing to the desired form. The final outline of the work is illustrated to the right of this illustration, and each succeeding diagram shows the condition of the work as it progresses step by step toward completion. The pattern is made to cast the knee bearing as illustrated in the left-hand diagram, and the first operation consists of planing surface *A* with a round-nosed tool. After this

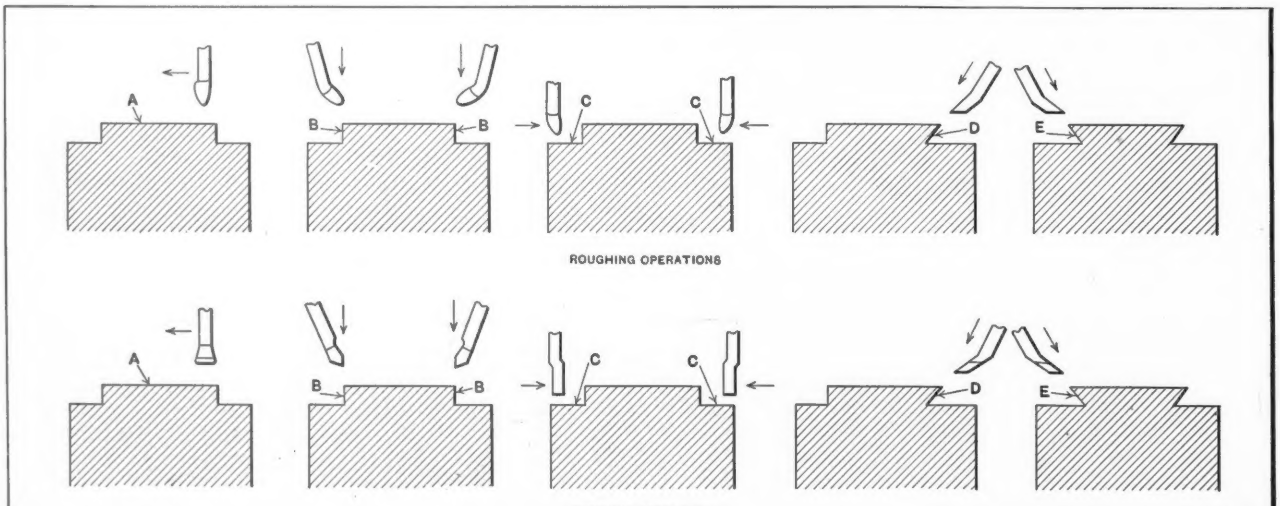


Fig. 4. Diagram showing Successive Steps in performing the Planing Operation illustrated in Fig. 3

cut has been taken, the next step is to plane down the side faces B to reduce the projection to the required width. Then faces C are planed with round-nosed tools. Faces A, B, and C are next finish-planed with tools of the form shown in the lower row of diagrams. Then the head of the planer is set over to an angle, as shown in Fig. 3, to provide for rough-planing side D, Fig. 4, of the dovetail bearing, after which the position of the head is reversed to give an angular setting to rough-plane surface E. These operations on faces D and E of the dovetail bearing are then repeated with finishing tools of the form shown in the lower diagrams. This diagram and those in Figs. 6 and 15 are for the purpose of showing the manner in which successive planing operations are performed in bringing a piece of work to the required form, and the methods of using different types of planer tools, rather than to give detailed data concerning the performance of any special planing operations. The production time on this job is six hours.

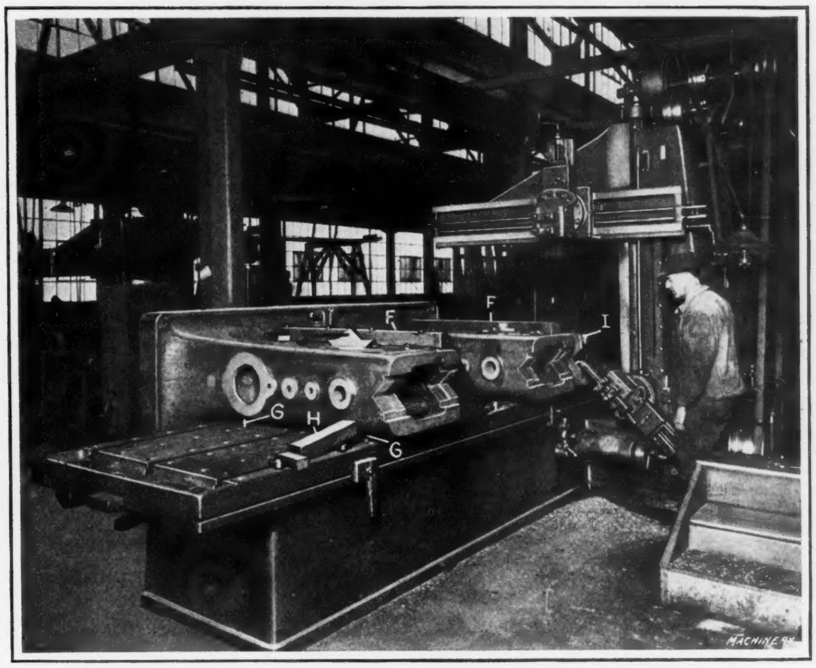


Fig. 5. Open-side Planer equipped for planing Over-arm Bearing in Two Milling Machines

Planing the Over-arm Bearing on Cleveland Milling Machine Columns

Readers of MACHINERY are familiar with the square over-arm that is used on Cleveland milling machines built by the Clark-Mesker Co. Open-side planers built by the Cleveland Planer Co. are used for machining the over-arm bearing in the column; and this operation shows a more typical use of a machine of this type, as the open-side feature affords sufficient capacity for handling these large castings. Fig. 5 shows one of the machines in operation, and Fig. 6 illustrates diagrammatically the way in which successive cuts are taken for the performance of this operation, and the form of tools that are used. Referring to the first of these illustrations, it will be seen that two work-holding fixtures F are provided on the planer table, against which the previously planed knee bearings on the columns are clamped. The weight of the castings is supported by jacks G, and end-stops H are employed to hold the work against possible movement resulting from the thrust of the tool.

With the work set up in this way, it is required to plane the top of the milling machine column to the form shown at the right-hand side of Fig. 6. The pattern is made to cast the top of the casting as shown in the left-hand diagram, and the first step is to rough-plane faces A with a round-nosed tool held in a horizontal position by the side-head. Next the offset tools are employed for planing opening B to size; and round-nosed tools held in the indicated positions are used for taking a roughing cut on faces C. Faces A, B, and C are then finish-planed with tools of the forms indicated. Next, the planer head is set to the required angle, and with a dovetailing tool mounted on the block, the face D is rough-planed. Keeping the tool-head in the same position, a tool of the form shown is set up for planing face E. Then, a similar setting of the tool-head is made, with the tool inclined in the opposite direction, to provide for planing the two surfaces F and G. After this sequence of operations has been completed on faces D, E, F, and G, the operations are all repeated for a finishing cut, using tools of the forms indicated. In Fig. 5 it will be seen that there is a tool-setting gage I at the back of the rear fixture F, that facil-

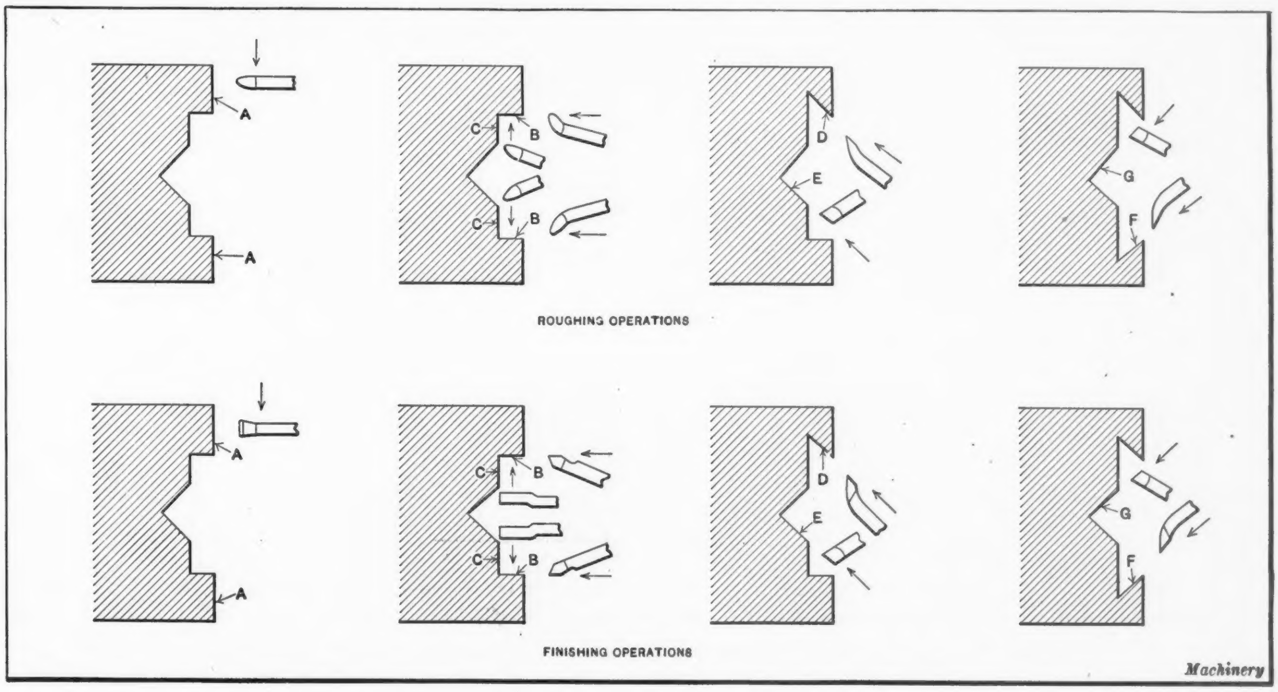


Fig. 6. Diagram illustrating Successive Steps in performing the Planing Operation shown on the Machine in Fig. 5

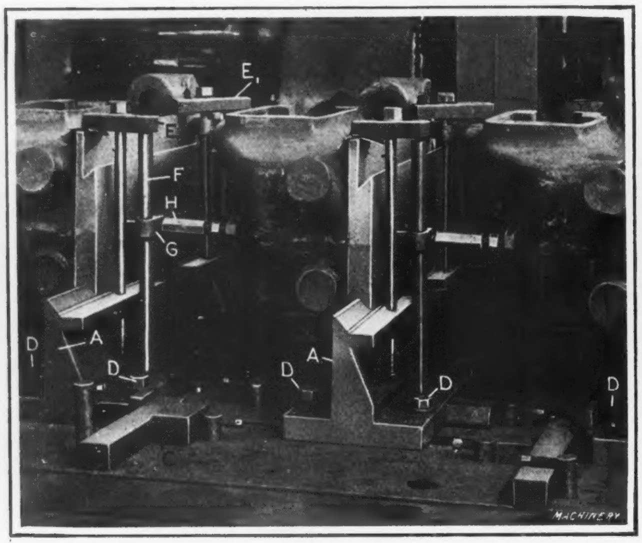


Fig. 7. Fixture for holding Milling Machine Knees while planing the Column Bearing

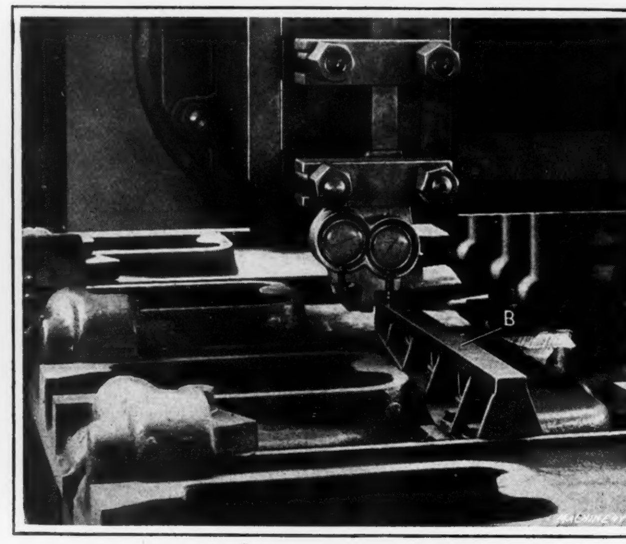


Fig. 8. Three-way Square and Duplex Dial Indicator for lining up Knees before planing

itates the work of setting the tools for planing the various surfaces on the work. At *J* there is shown a gage for testing the form of the planed work. The total time required for performing this sequence of operations on two milling machine columns is eighteen hours.

Planing Cincinnati Milling Machine Knees

Figs. 7 to 10, inclusive, illustrate another good example of production work done on a Cincinnati planer in the plant of the Cincinnati Milling Machine Co., in Cincinnati, Ohio. This operation consists of planing the column bearing on the knees for Type 2M machines, and prior to the performance of this operation, the knees have had the saddle bearing and the fit for the feed-box finish-planed, so that these surfaces may be utilized as locating points in setting up the work. Attention is first called to Fig. 7, where it will be seen that each casting is supported on a work-holding fixture *A* which is arranged with a V-bearing to engage the saddle bearing. In setting up this job, a string of twenty-two castings is mounted on the table, and great care has to be taken to so line up the work that the column bearing on each knee will be planed exactly at right angles to the saddle bearing and to the seat for the feed-box on the knee.

For accomplishing this result, use is made of a special form of square and a special indicator furnished with two dials, the use of these special setting-up tools being illustrated in Fig. 8. From this illustration, it will be apparent that the contactor points of the two dial indicators are arranged so that they engage the top and the side of bar *B*, which is one leg of the special square. This square has two other legs (not shown in the illustrations) which rest against the finish-planed top face of the saddle bearing that is best shown in Fig. 7. One of these legs stands in a vertical position and the other lies horizontally against the finished face of the work. A little thought will make it apparent that the use of a square of this kind, in conjunction with the two dial indicators, provides a convenient and accurate method of squaring up the castings ready for planing, because with the square in contact with the work as described, the finished saddle bearing on each knee must be at right angles to the line of travel of the planer table, in order for the two indicator points to be traversed back and forth along bar *B* without causing any deflection of the dial indicator needles. It will be evident that, used in this way, the square aligns the work to the line of travel of the planer table and provides for planing the column bearing on the knee at right angles to the previously planed saddle bearing.

Method of Setting up the Work and Fixtures

In connection with the following description of the method of setting up the fixtures and work for performing this planing operation, attention is directed to Fig. 7 which shows the arrangement to the best advantage. Bearing in mind that the previously planed bearing for the milling machine saddle is utilized as a locating point, the work being supported from the dovetail and located against the finished face of the fixture *A*, it will be evident that the fixtures may be conveniently squared up relative to the line of travel of the planer table by means of the special square *B* and dial test indicators shown in Fig. 8. The fixtures are put in place

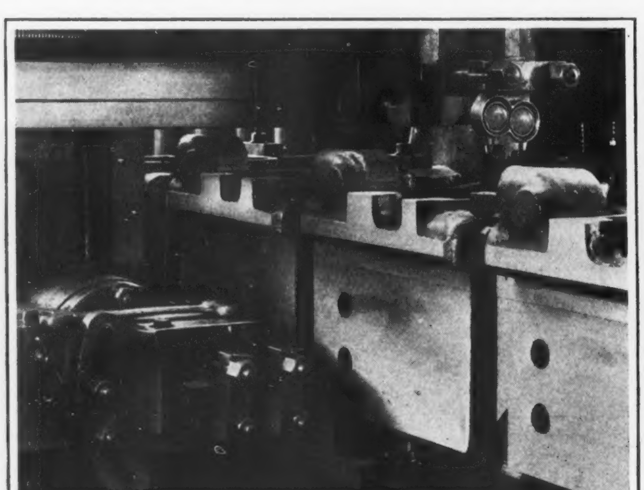


Fig. 9. Close-up View of Side-head used for planing the Column Bearing on Milling Machine Knees

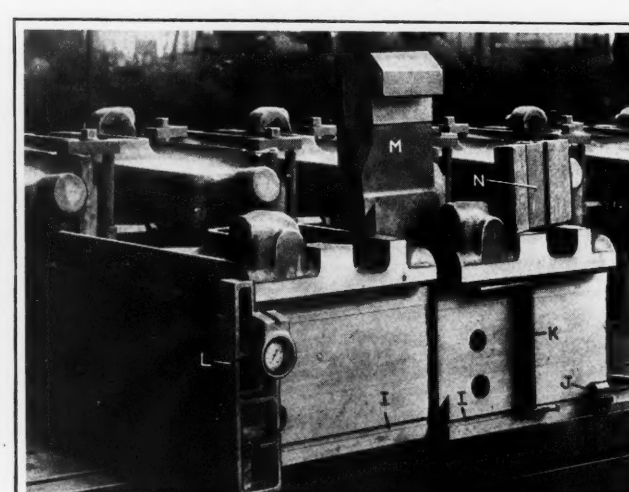


Fig. 10. Close-up View of Milling Machine Knees, showing Gages for testing Accuracy of Planed Column Bearings

on the planer table and the castings placed on them. The fixture at the end of the table nearest to the planer tools is next lined up, after which stops of the form shown at C, Fig. 7, are placed behind the fixture, and the adjusting screws are located to hold it in position.

Parallel spacing strips are placed at each end of the front of the first fixture in the row, and the next fixture of the line is then set against these strips, the same procedure being repeated until all twenty-two fixtures have been set up on the machine. After this approximate location of the fixtures has been obtained, one of the parallels is removed from between each fixture, care being taken not to disturb the position of any of the fixtures; and stops furnished with adjusting screws are substituted to secure the fixtures in place on the planer table. Then the milling machine knees are placed on the fixtures and a final adjustment of their position is obtained by means of the special square and dial test indicators shown in Fig. 8. A high degree of accuracy is required in the work done at this setting; and to attain such a result it is important to provide a perfectly rigid foundation for the work. With this idea in mind, it will be seen that packing papers are placed between the fixtures and the planer table at any point where there seems to be the least evidence of lost motion and consequent vibration.

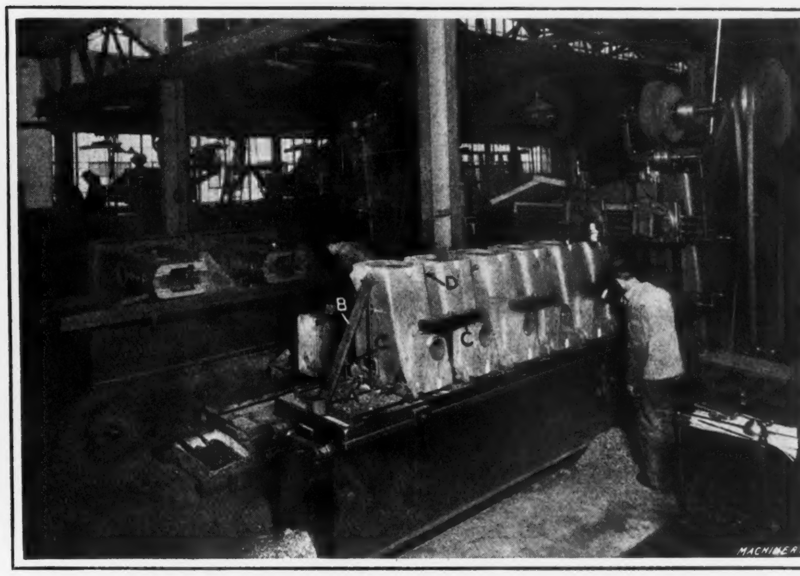


Fig. 11. Open-side Planer using One Rail-head and One Side-head simultaneously for planing Milling Machine Knees

Method of Clamping the Work in Place on the Fixture

It will be evident from Fig. 7 that so far as the procedure followed in clamping the fixtures to the planer table is concerned, the method is quite simple. Bolts D at each corner of the fixture provide for clamping it down to the planer table, and each fixture is held against endwise movement by means of various stops of the general type shown at C. It has already been explained that the work is supported on the fixture from the dovetail bearing, as clearly shown in Fig. 7, and provision is made for clamping down the casting by means of straps E_1 and E_2. It will be seen that strap E_1 is arranged to straddle the gap between two adjacent castings in the row, thus providing for holding them both; but at the opposite end, the contour of the milling machine knee is such that it would not be a desirable arrangement to have a strap extend right across the gap, and so strap E_2 is arranged with a post F to support its outer end. The way in which the clamping bolts extend up from the fixture will be evident from the illustration, without requiring description. However, it may be well to mention that on each post F there is a bracket G that supports a jack H, which extends between two adjacent castings to support the end thrust of the planer tools. The use of such jacks is not required at the opposite side of the row of castings owing to the steadying effect of straps E_1.

With the work set up in this manner, the planer-hand proceeds to perform the rough-planing operation on the column bearing on the knee, this work being done with the side-head of the planer as illustrated in Fig. 9. Fig. 10 illustrates two of the finished castings, with the various gages that are used for testing the accuracy of workmanship shown in place. Near the bottom, there will be seen a narrow slot I that is used for anchoring the opposite side of the dovetail bearing to the knee, and it is for the planing of this slot that the tool shown in Fig. 9 is employed. Everyone familiar with the requirements of high-grade milling machines as regards accuracy will realize that it is necessary to have the column bearing on the milling machine knee planed at exact right angles to the saddle bearing; and the greatest care must be exercised in holding all dimensions on the work within very close limits, in order to avoid the possible existence of lost motion and other undesirable features.

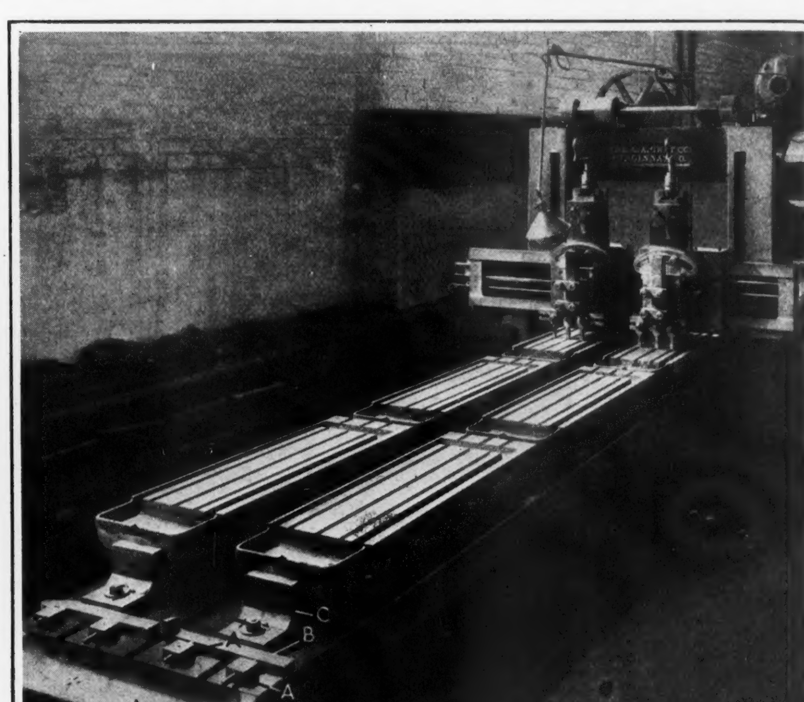


Fig. 12. Simultaneous Planing of the T-slots of Two Rows of Milling Machine Tables to ⅝ Inch Standard Width

To assure attainment of the required degree of accuracy in planing, it is important to have each of the work-holding fixtures and each piece of work set with the finished face of the fixture and the previously planed saddle bearing of the knee at an exact right angle to the line of travel of the planer table, as previously described. In taking the first cut, there is a substantial amount of metal to be removed, and as a result the tools exert considerable pressure, which may disturb the setting of the fixtures. Hence, it is the practice to loosen the clamps securing the

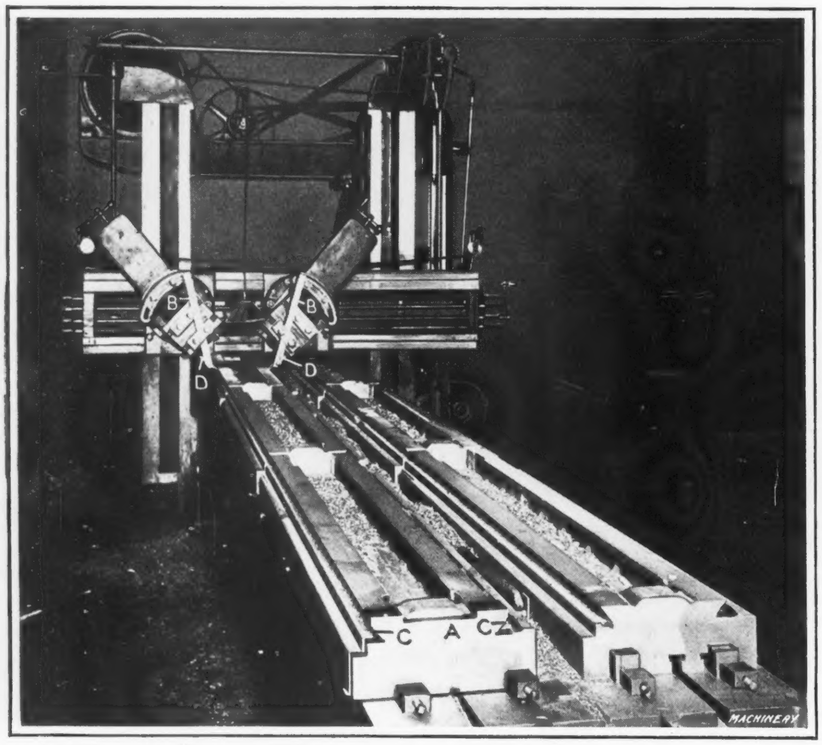


Fig. 13. Planing the Under Side of Two Rows of Milling Machine Tables

fixtures to the planer table and reset them between the performance of the roughing and of the so-called straightening out and finishing cuts. After the clamps have been loosened, the square *B*, Fig. 8, and the dial test indicators are used successively on each casting to line it up accurately with the line of travel of the planer table by the use of the adjusting screws in the stops; after the castings are lined up, the clamps are retightened to secure each piece of work and its fixture in this position. The method of procedure is to loosen bolts *D*, Fig. 7, and all of the clamps, after which any fixture is free to have its position adjusted by swinging it on the parallel spacing strip between fixtures.

Amount of Metal Removed by Successive Cuts

In performing the rough-planing operation, it is planned to leave 0.025 inch for the straightening out cut, which is taken in such a way that 0.010 inch is left for removal by the final finishing cut. The roughing cuts are taken at a speed of 43 feet per minute with a feed ranging from 1/16 to 1/8 inch, and the straightening out and finishing cuts are performed at a speed of 35 feet per minute, with a feed ranging from 1/4 to 1 inch, according to the position on the work at which the tool is operating. Hand feed is employed for the performance of planing operations in the dovetail bearings and in the slot *I*, Fig. 10. The actual work of planing the various dovetail bearings and flat surfaces on these castings is performed in accordance with the general principles which have been explained in connection with preceding jobs. Attention has already been called to the high degree of accuracy that is required in the performance of planing operations on these milling machine knees. All dimensions are required to be within 0.0005 inch of the specified size, and the column bearing on the knee must either be at exact right angles with the saddle bearing or not over 0.001 inch "in favor." This term is used to denote a relationship between the column and saddle bearings of the knee that would result in assembling the table on the milling machine in such a way that its edge farthest from the column would be held higher than the edge nearest to the column. This is termed "in favor," because the weight of the work and fixtures, and the pressure of the cutters are supported by the knee, and obviously it is permissible to have the outer end of the knee 0.001 inch high, but never low.

Gaging and Inspecting the Finished Work

Before the work is removed from the machine, all dimensions are carefully measured and the contour of all formed surfaces is gaged to make sure that the required degree of accuracy has been obtained. The square *B* and the duplex dial indicator shown in Fig. 8 are again utilized in making the final test of whether the column bearing has been planed perpendicular to the saddle bearing. Then gages shown in Fig. 10 are employed for testing other dimensions. A "Go" and "Not Go" gage *J* is utilized for testing the width of slot *I*. The distance from this slot to the dovetail bearing must be held within limits of 0.0005 inch, and gage *K* is used for testing this dimension. It will be seen that a plug is used, which fits accurately in the slot and supports a length bar that has a ground cylindrical shaped member at its upper end. This gage is of the "Go" and "Not Go" type, the lower end of bar *K* being ground to two different lengths, one of which must allow the plug gage to enter slot *I* while the other makes it impossible to enter the plug in the slot.

Another dimension that is of vital importance, is the distance between the dovetail of the knee bearing on the column and the dovetail for the saddle bearing. For the testing of these dimensions, a special dial indicator *L* is employed. It is first set to a master gage *M*, allowing 0.002 inch of metal for scraping, and the needle is set to zero. Then the indicator can be used on the work and if the required accuracy has been obtained, it will continue to indicate zero. Any deviation from the zero reading shows an error in the spacing between the saddle and column bearings on the milling machine knee. Finally, the form of the dovetail bearings is

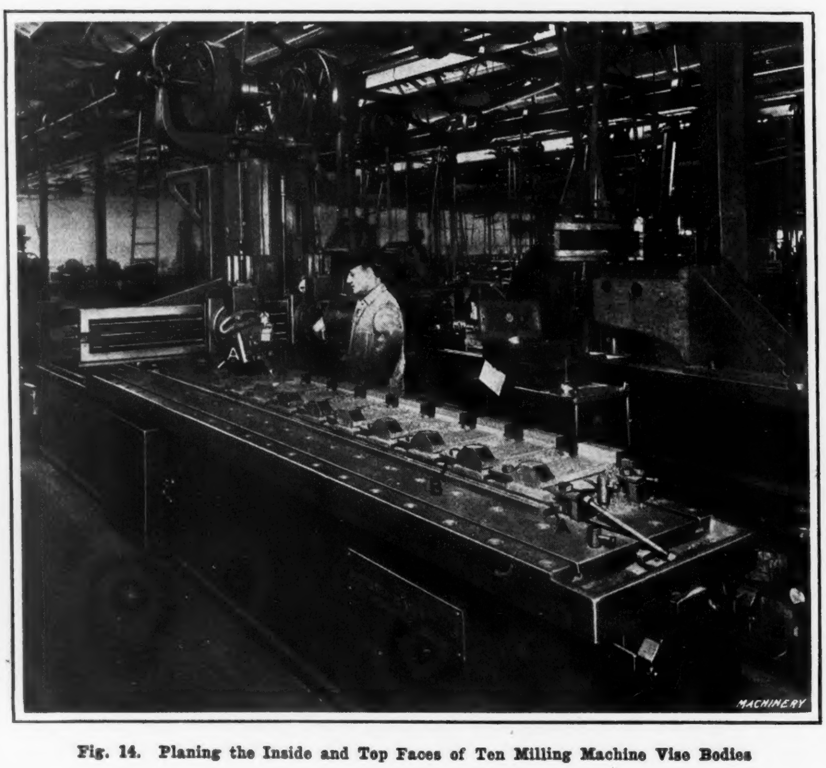


Fig. 14. Planing the Inside and Top Faces of Ten Milling Machine Vise Bodies

tested by means of a master plate *N* which is rubbed on the work with a coat of red lead on the plate, in order to test the form of the planed bearings.

Types of Planer Tools Used on Cincinnati Miller Knees

For the performance of rough-planing operations on the knees for Cincinnati Type 2M milling machines, the roughing operations are performed with the familiar round-nosed tools, which are forged in various shapes so that they can conveniently reach the surfaces on which they are to operate. Roughing cuts on the dovetail bearings are taken with dovetailing tools of the general type illustrated in Figs. 4 and 6, and the slot *I*, Fig. 10, is rough-planed with a square-nosed tool that is fed straight into the work. The so-called straightening out cuts on flat surfaces are taken with diamond point tools, while the finishing cuts are performed with square-nosed spring tools. For the performance of finishing operations on the dovetail bearings, use is made of dovetail finishing tools of the forms shown in Figs. 4 and 6.

Planing Operations on Cleveland Milling Machine Knees

In Fig. 11 there is shown the application of a Cleveland open-side planer in the Clark-Mesker plant, for use in simultaneously planing the front end of Cleveland milling machine knees and the bottom of the bearing for the elevating screw. It will be seen that six of these castings are set up in a string, and the two operations are performed simultaneously with tools carried by the rail-head and the side-head of the machine. In setting up the castings, stops *A* are employed to support the pressure of the tools and to square the work up with the line of travel of the planer table. The action of these screws is supplemented by a brace-bar *B*, and the work is held down on the table by means of straps *C* and smaller straps at the opposite side of the work. Placed between adjacent castings in the row are small jacks, which are employed to afford support and reduce the danger of developing vibration. The actual work performed on these castings is quite simple. It consists of the use of a round-nosed tool in the rail-head and of a similar tool in the side-head for the performance of a roughing operation on the two faces that are to be planed. Then after these cuts have been taken, the surfaces are finished with square-nosed tools used in the same manner. The production time for six castings is six hours.

Planing Tops of Tables for Brown & Sharpe Milling Machines

Fig. 12 shows a 30- by 30-inch by 30-foot planer built by the G. A. Gray Co., Cincinnati, Ohio, in use in the plant of the Brown & Sharpe Mfg. Co., Providence, R. I., where it is employed for planing the top or working surface of milling machine tables.

As the foundry delivers milling machine table castings to the machine shops, it is the practice to first rough-mill the castings on the bottom and then on the top. After this has been done, they are finish-planed, first on the top and then on the bottom. The preliminary surfacing is done on the milling machine to increase the rate of output, and the final finishing is done by planing because this is regarded as a method that gives a higher degree of accuracy. The castings are allowed to season for a short time between milling and planing. As the work comes to the planer, the rough-milled under side is available as a location point. The method of setting up is relatively simple, eight castings being arranged in two parallel rows of four castings each. On this job the same provision is made for supporting the end thrust as that which has been mentioned in connection with numerous other planing operations, although the actual means of accomplishing this result are somewhat different.

Reference to the illustration will make it apparent that at the end of each row of castings on the planer table there are two stops *A* that are carried in clamping bolt holes; but instead of having the work bear directly against these stops, an intermediate bar *B* is arranged to bear against a block *C*, the end of which is machined to engage a finished surface at the end of the milling machine table casting. It will be seen that block *C* is secured to the planer table by a bolt *D*, and each milling machine table to be planed is located for alignment by the fixture in which it is carried. Stops *A* and bars *B* are used more as a precautionary measure to assure rigid support of the work than because they are actually necessary.

While the work is set up on this machine, it is required to plane the top surface of the milling machine table castings and also to finish the T-slots, the latter operation being shown in progress in the accompanying illustration. It will be evident that this is quite a simple job, the chief point of interest being the arrangement of the tool-holders for supporting three cutter bits. It will be seen that the holder is made in the form of a letter T with a T-slot arranged in the cross-bar on which three cutters are mounted. Each cutter is held in position by a bolt in this T-slot, making it a very simple matter to adjust the distance from center to center of the cutters for handling different sizes of milling machine tables. The T-slots are rough-milled, after which the vertical part of each slot is planed to a standard width of 5/8 inch, and then the edges at the top and bottom of the vertical slot are chamfered.

Planing the Under Side of Brown & Sharpe Milling Machine Tables

Fig. 13 shows a 30- by 30-inch by 24-foot planer built by William Sellers & Co., Inc., 1600 Hamilton St., Philadelphia, Pa., which is used for performing the finish-planing operation on the under side of Brown & Sharpe milling machine tables. The procedure followed in setting up the castings is similar

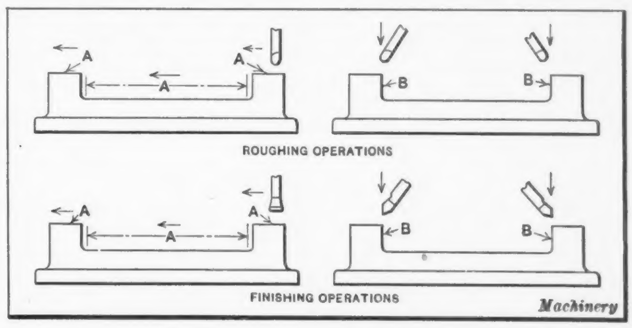


Fig. 15. Diagrams illustrating the Order in which Roughing and Finishing Operations are performed in planing Vise Bodies on the Machine illustrated in Fig. 14

to that of cases which have already been described, but attention may be called to tool-setting gage *A*, made of hardened steel to exactly duplicate the required cross-section of the slide bearing which must be finished on the under side of the milling machine table. An explanation has already been given of the way in which such a setting gage is used for properly locating tools for planing work to the required dimensions where accuracy is essential. It will be evident that on the job which is here illustrated there are ten surfaces to be planed, and gage *A* provides for properly locating the tools for operation on each of these faces of the work. As shown in the accompanying illustration, the tool-holders *B* are set for finishing the inclined faces *C* of the dovetailed slide bearing. For handling this part of the work, use is made of tool-holders with cutter bits *D* set at such an angle in the holders that the points can follow the inclined surfaces to be machined on the under side of the dovetail, without interference between the tool-holders and the work. It will be evident that the surfaces to be finished are in two groups comprising pairs of similar faces. For this reason two tool-heads on the planer cross-rail are used simultaneously with a substantial saving in the time required to finish the job.

Planing Cleveland Milling Machine Vises

Fig. 14 shows a Cleveland open-side planer used at the Clark-Mesker plant for planing the bodies of milling machine vises. This is quite a simple operation consisting of planing the top faces of the vise body and the sides and bottom of

the opening. In setting up these pieces, a different principle is employed from any which has been previously illustrated and described. The pieces have been machined on their under sides, and there is a finished shoulder that can be utilized as a locating point. For this purpose, it will be noticed that two parallel strips *A* are secured to the planer table, so that the castings to be planed can be laid across these strips, with the machined shoulder on the under side resting against the strip. Then straps *B* extending from casting to casting in the string, are utilized to hold the work down; and the familiar arrangement of stops is employed to prevent the thrust of the tool from causing endwise movement of the work.

With a round-nosed tool mounted in the rail-head, a roughing cut is first taken across the tops of the two lugs on the work and across the bottom surface, as shown diagrammatically in Fig. 15, the feed of the head along the rail being utilized for this purpose. Then the inner sides of the lugs are planed with the same round-nosed tool, utilizing the vertical feed of the rail-head. After completing these operations, the same surfaces are finish-planed with a broad square-nosed tool. For planing ten castings set up on the machine in the manner described, the production time is eight hours.

In the February number of MACHINERY there will be published the second installment of this series of articles, which deals with the planer practice of representative lathe-building plants.

* * *

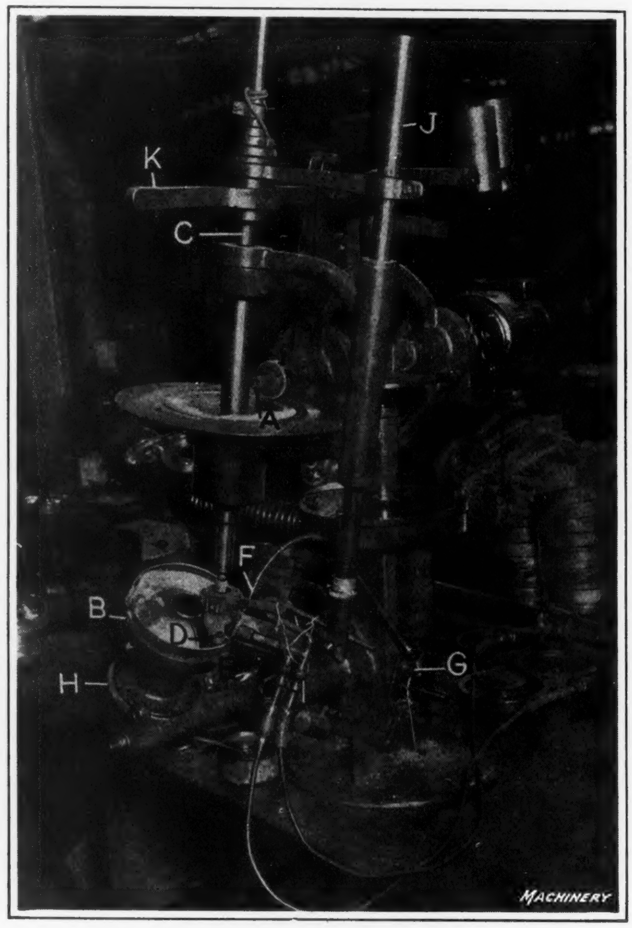
AUTOMATIC OXY-ACETYLENE CUTTING MACHINE

One of the most interesting British developments in connection with shop equipment, says our London correspondent, is the combination of the oxy-acetylene or oxy-hydrogen cutting blowpipe with the full automatic movements with which a universal type of machine tool is equipped. In effect, a new type of machine tool is available. The machine which is made by the Godfrey Engineering Works of Wood Green, London, England, has a T-slotted base, on one corner of which a pedestal is mounted, the pedestal carrying a swinging radial arm somewhat on the lines of a radial drilling machine. From the end of the arm is hung a cross-slide, carrying a second slide arranged at right angles to the first. A carriage hung from the lower slide carries a rotating arm, the radius of which can be varied. The cutting blowpipe is carried at the extremity of a light arm, pivoted at its other end to a second arm which, in turn, is pivoted to the pedestal. These arms are supported in ball bearings so that the blowpipe can be moved with practically no friction to any position in a horizontal plane. A pin on top of the blowpipe can be engaged in a hole in the rotating arm and causes the blowpipe to follow any movement of the slides or radius arm.

Feed is obtained from a light belt drive or small independent motor which drives through a pair of change-speed boxes, giving a feed ranging from ½ to 15 inches per minute to the blowpipe. Owing to the regularity of feed, remarkably clean cuts are possible, and a considerable economy in oxygen is effected. Plate 1 inch in thickness can be cut at the rate of 15 inches per minute with an oxygen pressure of only 20 pounds per square inch, the jet orifice being only 0.047 inch in diameter and the resulting cut 0.050 inch in width. A corresponding economy is effected in other plate thicknesses. By the use of templets cut from sheet fiber or thin wood, any irregular shapes can be cut, still using the automatic and regular feeds. As an instance of the accuracy with which cuts can be made, gears of 2 inches pitch and 16 teeth have been cut from ½-inch plate in sixteen minutes each, the finish being so good that the gears have run in mesh without dressing, the clearance being far less than would have to be allowed in cast gears of the same pitch even with dressing.

FILLET SOLDERING MACHINE

The accompanying illustration shows a soldering machine developed by the De Laval Separator Co., Poughkeepsie, N. Y., for the purpose of soldering the rims to the tin covers of cream separator bowls. A number of these covers are shown in the illustration, from which the nature of the work that this machine is engaged in performing will be understood. The soldered joint is a fillet extending around the interior edge of the covers, and the machine automatically makes this joint after the operator places the work in position. The machine is driven by a one-half horsepower electric motor, and the driving shaft *A* transmits power to both the work-holder *B* and the spindle *C*, by means of a friction disk drive. The speeds of both the spindle which carries the soldering iron *D* and the work, can thus be regulated to suit the diameter of the covers being soldered. A gas flame impinges against the point of the iron and the end of the soldering wire at *E* so that an even flow of solder



Special Soldering Machine used in the Manufacture of Tin Covers

is deposited as the work slowly revolves. The result is an even fillet without breaks or irregularities. The soldering wire *F* is fed to the work from a spool located underneath the bench on which the machine is mounted, and suitable feed-rolls *G* are provided for the purpose of delivering an even amount of wire to the flame. The power for driving the work-holder is transmitted from the main vertical spindle by means of suitable gearing held within case *H*. An operating lever *K* is provided for raising the soldering iron from the work by means of connections with shaft *J*. An inexperienced workman can operate the machine.

* * *

The total imports of machinery of all kinds into New Zealand during 1920 amounted to about $6,000,000, of which electrical machinery represented about $3,500,000. The imports of machine tools represented a value of about $85,000, and all other metal-working machinery, about $12,500.

The Business Outlook for the Coming Year

By A. W. HENN, President National Acme Co., Cleveland, Ohio

In this article Mr. Henn outlines briefly his opinions as to the business prospects for the coming year. He points out that the railroads undoubtedly will become an important factor in machine tool buying, and that machine tool prices as a whole are not likely to be reduced materially, because the costs in this industry have not yet been reduced so as to warrant any cut in prices. He further deals with a very interesting method of taxation that has been proposed to take the place of the present excess profits tax, the results of which have proved extremely harmful to the nation as a whole, in that the tax has penalized capable management, encouraged waste and inefficiency, and been one of the principal causes for the extreme price increases.

NOTWITHSTANDING the fact that the machine tool business is passing through a period of depression, the industrial outlook throughout the nation, viewed in its broad aspect, is encouraging, and the industries generally may safely be said to be in a good condition. The automobile industry and the allied enterprises depending upon it are exceptions to this general statement. During the past year machine tool manufacturers have been called upon to equip automobile industries to the exclusion of almost all other lines of industrial endeavor, and this has tended to give them the idea that as soon as the demand from this one industry—important though it be—fell off there would be no other business in sight. This, I believe, is an erroneous impression, and it might be expected that the coming year will see a revival in several other industries that have not been very active for several years.

The Railroads as Prospective Buyers

A revival of the machine tool industry may be expected in the spring. By that time the general readjustment now taking place will have found its level, and the railroads, placed upon a firm financial footing by the increases in rates and fares allowed them, will be able to enter the market as buyers of machine tool equipment much needed by them. It is reasonable to presume that the important factor in the machine tool industry for some years to come will be the demand made upon it by the railroads; and as the demand falls off from the automobile factories, most of which are now well equipped and not in need of enormous quantities of machine tools for immediate delivery, the railroads will step in and occupy the center of the stage.

The needs of the railroad shops have repeatedly been pointed out and require no elaboration. The only thing that has prevented the railroads from buying during the last few years has been the depleted condition of their finances. Now, with the railroads receiving a greater income than ever on a falling market both in labor and materials, they should be in an exceptionally fine position to become active buyers, and there is no doubt that they will take full advantage of the opportunity offered them.

The Price Situation in the Machine Tool Field

It may as well be understood at the outset that there can be no material reductions in machine tool prices for some time to come. In the first place, present prices of machine tools are reasonable as compared with the prices still maintained in most other commercial fields. In the second place, there has been no reduction in costs up to the present time. What slight reductions there have been so far in raw materials have been of no direct value to the machine tool manufacturer, because he must always have a large stock of materials and parts in process on hand and those now carried were acquired, in the main, at the high market price for materials during the period of inflated prices. Recent comparisons of costs in the building of several lots of machines show that the present costs are a shade higher instead of lower than those of machines put through at previous dates. Wages are as high as ever, and while it may be expected that there will be a gradual reduction, following the reduced cost of living which is already in evidence, this reduction will be so gradual that its effect upon costs of machine tools will not be apparent for perhaps a year or more to come.

The General Business Outlook

At the beginning of this article it was stated that the general business situation in the country presents no alarming aspect. It is true that we are passing through a period of deflation, but at the same time there is no over-production, except possibly in a few special lines, and on the whole there is a latent demand for the goods produced by the industries that will not be filled for a long time to come even though the industries be running at full capacity. As an indication it may be mentioned that screw products show general activity in all standard lines. The shelves of the dealers are empty and the orders that were placed for replenishing their stocks have not been cancelled to any great extent. The dealers found during the past year of industrial activity that deliveries were often months away, and they apparently are not taking chances on cancelling, with the result that they might have to step down to the end of the line and wait for deliveries over a more or less further prolonged period.

In many of the industries not directly allied with the machine industry much of the depression that exists is due to the holding off of buying on the part of the general public in the expectation of lower prices, but just as soon as it becomes generally recognized that prices have reached the bottom, it is likely that there will be a resumption of buying that will again set the wheels of industry to work in a satisfying manner.

The Foreign Trade

There is unfortunately not much hope that the foreign trade will revive at a very early date, because the foreign buyer cannot pay present prices as expressed in his own currency, due to the abnormal exchange, and the American manufacturer is unable to finance him indefinitely. Eventually this condition will right itself, but there is no immediate prospect of a foreign trade that will be of much help to the machine tool builder under existing conditions.

The Question of Taxation

There is no more important matter for the new Administration and the new Congress to consider than a rational system of taxation. Experience has shown that the present excess profits tax is utterly harmful to the country. It penalizes capable management, and it encourages waste and unsound business practices. Various other methods of taxation have been proposed, all of which ought to be carefully considered, and the one which seems to afford the least objection should be chosen. A general merchandise tax, placing a flat or possibly graded percentage tax on every sale has been proposed. Something of this nature is applied in

France and in Canada, and appears to work reasonably well. Objections to this tax that may be serious have been raised, however, by these who have analyzed it, but very able expressions of opinion on this subject have been made by Jules S. Bache. An interesting analysis has been made by Theodore H. Price, publisher of *Commerce and Finance.* Mr. Price outlines another method of taxation which appears to be free from most of the objections that have been raised to the other systems, and which in addition seems to have many advantages.

This method proposes to place a percentage tax upon the payroll of every employer, the tax to be payable monthly. One of the advantages claimed is that there would be no duplication of tax, as there necessarily is in a general merchandise tax. Our federal taxes come chiefly out of industry in one way or another, so that the tax must be placed primarily upon the products of labor. A simple and direct way in which this can be done appears to be by a tax upon the total amount of wages paid by an employer. In this way the exact amount of the tax is known at all times. There is no unknown or indefinite factor involved, as in the case of the present excess profits tax. Such a tax should encourage thrift and economy in the conduct of business, and the total that must needs be added to the cost of the product in order to cover the tax can be determined with the same accuracy as the direct labor cost; hence, the tendency will be toward reduction in prices, because there is no need of adding an arbitrary percentage in order to cover the unknown factor of the tax bill. Furthermore, the tax could be paid in monthly installments, immediately when due, and if, owing to depression in business or for any reason whatsoever the payroll were reduced, the tax would automatically be reduced also. When business is in a prosperous condition the industries are easily able and likewise willing to pay an increased tax on an increased payroll. Without prejudice to the merits that may be claimed for a general sales overturn tax, manufacturers might do well to give this proposition some concentrated thought, and if this method of taxation meets with their approval, they ought to communicate their views to their senators and representatives, and also to such committees of Congress as will aid in shaping the new tax laws of the nation.

* * *

GRINDING-WHEEL SPINDLE OPERATED AT AN UNUSUAL SPEED

A description of two grinding-wheel spindles intended for operation at high speeds was given in the December number of MACHINERY. The accompanying illustrations show another type of grinding-wheel spindle designed for very fine internal grinding operations, which was exhibited at the Olympia exposition in England, being operated at the almost inconceivable speed of 104,000 revolutions per minute—over 1700 revolutions per second. This spindle is equipped with a wheel ¼ inch in diameter, and is the product of the A. A. Jones & Shipman Co., Ltd., Leicester, England. The spindle was driven from a pulley mounted on a shaft running at the

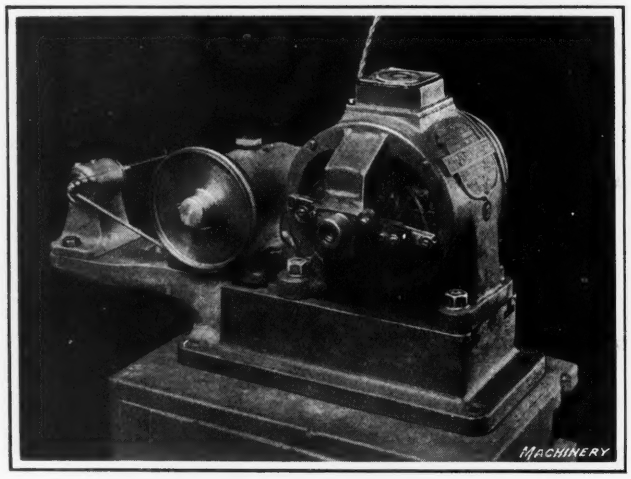


Fig. 2. Grinding-wheel Spindle which operates at 104,000 Revolutions per Minute, made by A. A. Jones & Shipman Co., Ltd.

rate of about 9150 revolutions per minute, this intermediate shaft being, in turn, connected to a motor pulley having a speed of 2500 revolutions per minute.

The type of bearing adopted is shown in the accompanying sectional view, Fig. 1. It will be observed that the path of rotation of the balls is in a straight line at right angles with the axis of rotation, and owing to the limits imposed in the manufacture of the races the balls rotate exactly on the center line of the curved races. The result is that there is no spinning effect. The balls are not caged, and as they are carefully graded, they keep perfectly spaced. Assuming wear to take place, the adjustment at the rear end of the spindle farthest from the wheel will tend to push the balls up the radial bearings, but in practice it is claimed that wear on the balls and races is infinitesimal, so that the adjustment is always in a straight line with the axis of rotation and there is no tangential effort of rotation other than at right angles to the axis. End play is impossible with the bearings correctly adjusted, because the construction provides a double contraction.

The driving belt is made from a particular quality of rubber, which is necessary to secure the desired results. The spindle apparently reaches its critical speed at 33,000 revolutions per minute, as when it attains approximately this speed, the belt starts to oscillate badly, but as the speed increases, this effect dies down and the belt again runs smoothly. This spindle is yet in the experimental stage, but it has been run hour after hour without undue heating, the period being apparently limited by belt endurance. It should be mentioned that the wheel was not cutting during these runs.

A more definite stage of practicality has been reached with the next size spindle, which is fitted with the same type of cup and cone bearings. This is designed to run at 40,000 revolutions per minute, and is fitted with a ½-inch wheel to give a surface speed of approximately 5000 feet per minute. This spindle is regularly in work at the maker's plant, and is said to have been operated at 37,312 revolutions per minute, grinding out hardened steel gears, with a band of rubber that had stood for three working days without stretching or warping. This spindle has been tested by the National Physical Laboratory up to a speed of 45,460 revolutions per minute.

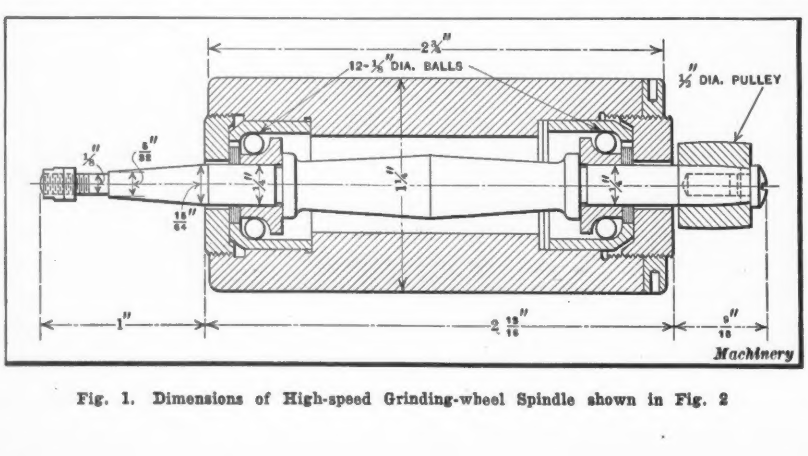
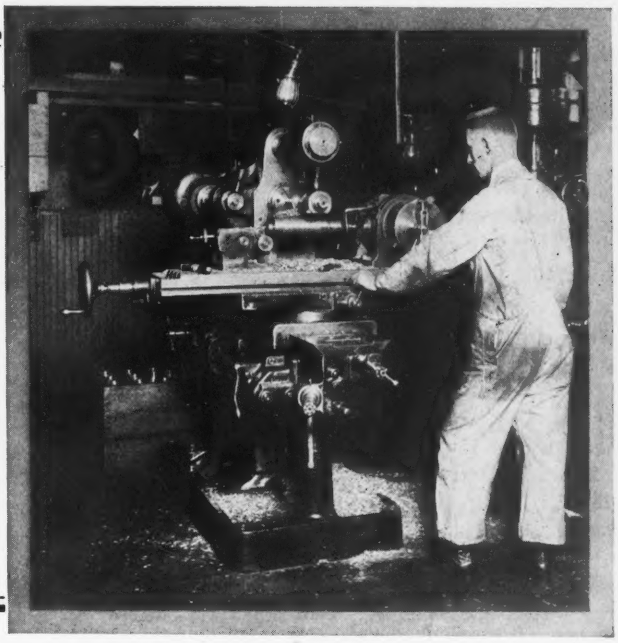


Fig. 1. Dimensions of High-speed Grinding-wheel Spindle shown in Fig. 2

* * *

The amount of freight handled on the railroads of the United States, increased from 1914 to 1919 by about 40 per cent. The damage payments due to losses and damage in transit increased by 222 per cent, involving payments for loss and damage of over $100,000,000 in 1919. Doubtless, here is an opportunity for the railroads to take steps that will result in a large saving.

Training Operators in a Machine Shop



A Detailed Description of the Methods Employed in the Plant of the Norton Company, Worcester, Mass., in the Training of Machine Shop Workers

By JOHN C. SPENCE
Superintendent Grinding Machine Division, Norton Co.

IN the article published in the December, 1920, number of MACHINERY, entitled "Increasing Production by Training Workers," the general principles upon which the Norton training department is based were outlined. It is proposed in the present article to describe in greater detail the organization of the training department, the methods used, and the results obtained.

At the Norton Co.'s plant a separate department has been set aside for the training of machine tool operators. This department is under the immediate authority and control of the superintendent of the machine division, and the same rules that apply to any production department of the shop apply to the training department. The training shop is under the direct supervision of a training supervisor, who has four instructors as his associates; these instructors give their entire time to this department, the idea being to have eight or ten men under each instructor.

The Objects of the Shop Training Department

The immediate objects of the shop training department may be stated as follows: (1) To carry out a predetermined policy of instruction; (2) to provide the shop with a good type of skilled workmen; (3) to teach the beginner the proper and safe way in which to operate machine tools; (4) to instill in the workman a pride in the honesty of the product, a respect for the rights of his fellow-workers and of the company for which he works, a sense of responsibility for the care of the company's property, and a desire to advance beyond the plane of the mediocre workman; (5) to influence the future attitude of the workers toward industry by giving them right impressions and correct information from the start; and (6) to provide an opportunity for partly skilled men already in the shop to obtain a more advanced training.

Incidentally, the shop training department makes it possible to obtain the following advantages: (1) It removes from the foremen of the production departments the burden of teaching beginners; (2) it decreases the amount of spoiled work in the factory, because of the careful training and supervision of beginners; (3) it stabilizes the labor turnover among skilled men by keeping out the floating group of transients; (4) it assists the employment department in distributing the men to the best advantage; (5) it provides a means whereby note can be taken of the qualifications and abilities of young men entering the shop, which may be of value when making promotions in the future; (6) it furnishes a man the means for finding out whether or not he is adapted for mechanical work, provided he is given the proper amount of training; and it saves him experimenting in the regular production departments where the opportunity is much smaller, and where the humiliation in case of failure is greater.

Equipment of the Training Department

The training shop is practically self-contained, that is, it has a complete equipment of the standard types of machine tools, jigs, and fixtures, and small tools, the same as a complete small machine shop. It has its own tool crib and washroom. The department comprises over 6000 square feet of floor space and is provided with the following machines and equipment:

14 lathes	1 universal grinder
1 speed lathe	2 tool and cutter grinding machines
5 horizontal milling machines	1 drill grinder
2 vertical milling machines	2 wet tool grinders
2 hand milling machines	1 screw slotter
2 two-spindle sensitive drilling machines	3 arbor presses
	1 straightening press
2 wheel and lever drilling machines	15 vises
	1 gas furnace
1 shaping machine	160 feet of benches

A department so equipped can handle sixty-five men at one time, including assemblers, but the usual number is between thirty and thirty-five. The training period averages six weeks, and as soon as the men are sufficiently trained, they are placed in positions open in the regular shop departments. On an average of from four to six men are transferred to the shop departments each week.

Starting to Work in the Training Department

Any man or boy over sixteen years of age is eligible for the training department if it is believed that he has the proper qualifications for making a good machinist and a valuable and loyal employe. Before being accepted he is required to pass a simple written examination in arithmethic, as it is considered that any man to be a good machine operator must understand the fundamentals of simple calculations. The examples given cover ordinary operations in whole numbers, fractions, and decimals. He also must pass a physical examination, after which the training supervisor has a talk with him, clearly defining what the company expects of the prospective machinist and what he, in turn, may expect of the company.

He is then given a booklet on safety rules for machine shop employes, and signs a statement saying that he will read it carefully and follow the rules that apply to his

work. He is further shown the location of the sub-hospital, how to register on the time-clock, and how to obtain tools from the tool crib, and supplies from the stores. His first lesson in actual machine tool operation begins with a practical talk at the machine on the dangers to avoid. This talk is repeated at intervals throughout the course, especially during the first few days.

Methods Used in the Shop Training Department

The first training course consists of a six weeks' intensive training in work on a machine. In exceptional instances, when the beginner proves to be of a superior type, he may be given a general training on all the various types of machine tools in the training shop, but this is an exception. He nevertheless has an opportunity to obtain an all-around training by passing into the shop from the training department after he has been trained on the lathe, and then coming back into the training shop after a certain period and receiving further training on another machine, and so on, as will be described later.

In the training shop, charts are posted indicating to the student each progressive operation that he will be taught, in the proper sequence for each machine. These charts also contain an outline of all auxiliary information, trade mathematics, and "shop science" that he should learn in connection with each operation. This places the scope and object of the training directly before each man, and gives him part of the responsibility for seeing that he gets all the training that the course offers. These charts, which are based upon Bulletin No. 52 of the Federal Board for Vocational Education, adapted to the needs of the Norton Co., also guide the instructors in laying out operations in the proper sequence for each man.

Fig. 1. Six Weeks of Intensive Training makes a Good Lathe Operator out of a Beginner

A given number of hours for training in each operation is stipulated, but each student must do the work habitually well, before he is permitted to do the next operation. If he does not show increasing ability as he advances in the work, the training supervisor explains to him that as he shows no aptitude for the work, it would be better for him to secure a job in some other occupation or trade. He is given an opportunity to secure this new job while still working for the company, so that he may leave the training department without publicity as to the reason for his doing so, thereby preserving his self-respect.

There is at present no class-room work in connection with the shop training. Such instruction as is required is handled by each instructor according to the lay-out of the chart for each operation, and each man being trained is dealt with individually. The operator being trained is expected to insist that he receive the instructions called for by the chart. It is not thought, however, that class-room work does not fill a proper place, provided it is conducted by a practical machine shop man, using throughout the instruction concrete shop problems. This part of the training program is handled by another department called the educational department by means of evening classes, but nevertheless the classroom work will always be supplemented with further individual instruction on the job, in the same way as it is now carried out.

The Training Shop is an Actual Production Department

It should be understood that the training shop is not a mere school but is an actual production department, aiding in carrying on the shop production. It has the authority to divert from the regular shop departments to the training department twenty-five pieces of any kind of work that affords training value. An inspector from the regular shop inspection department inspects all the work done in the training shop, and must be absolutely impartial in his judgment, because the parts that pass from the training shop enter into the regular manufacturing routine. In addition to the regular production work, the department takes care of all repair parts for the company's machines ordered by outside customers. An idea of the amount of work turned out by the training shop may be gained from the fact that one inspector is kept busy continuously inspecting work from this shop alone.

Promotion from the Training Shop to the Production Departments

From time to time, sometimes several times a week, the training supervisor and the general foreman of production hold a conference at which they consider which men in the training shop are fitted to take jobs that have opened up in the factory. When a man has been chosen for a given job by these two men, the foreman of the department for which he is proposed is informed, and his opinion asked. The foreman has the privilege of stating any objection that he has to the man, and may ask for any man in the department that appears to him to be better qualified for the work.

After the man has been transferred to the shop, the training supervisor keeps in touch with him for several weeks, encouraging him and advising him, and if he finds it necessary, he occasionally takes him back to the training shop for further instruction and training.

How a Man Receives an All-around Shop Training in the Training Shop

When a graduate of the training shop has been promoted to a production department, he must remain in this department at least three months and make a satisfactory record, before he can return to the training department for additional training on another type of machine tool. He must also have shown that he has the ability that warrants the company in giving him the opportunity. He then again returns to a production department, staying there another three months, after which he can return and obtain training on still another machine tool. The subsequent training periods usually last only from two to four weeks.

In this way an exceptional man can become an all-around machinist in about two years, and will have received, it is believed, a much better training than the ordinary apprentice receives in four years' time. Such a course of training will be distributed about as follows: Six weeks' lathe work in the training shop; three months in the shop in the lathe department; from two to four weeks' milling machine work in the training shop; three months in the milling machine department; from two to four weeks' drilling practice in the training shop; three months in the drilling department; from two to four weeks' training on planer and shaper work in

the training shop; three months in the planer or shaper department; from two to four weeks in the training shop on universal grinding machines; three months in the grinding department; and finally, from two to four weeks' training in the training shop on tool and cutter grinding. At this time the man may claim to be an all-around machinist, and will be able to more than measure up with the average man trained by the four-year apprenticeship method.

During the three-month periods when the man is in the shop, he works as a piece-worker and attains the required speed necessary to become a good operator. It is also a test of the ambition of the man if he wants to come back into the training shop in order to become an all-around machinist. A great many of the men trained, do this, but, of course, there are others who, after having received training on one or two machines will remain operators on those machines continuously.

Compensation Paid in the Training Shop

In order to attract the right kind of young man it is necessary that the compensation paid in the training shop be at least sufficient to meet his actual needs of maintenance.

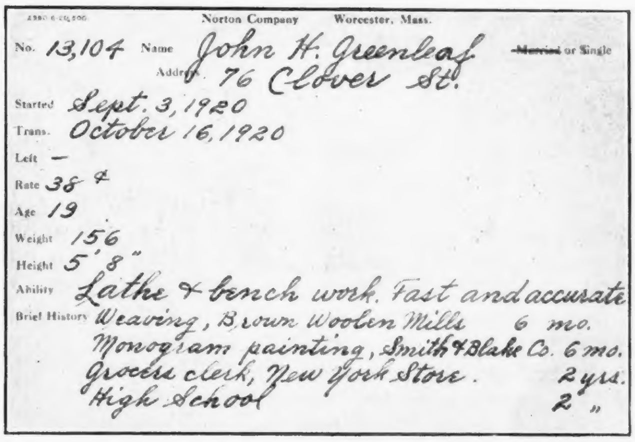

Norton Company Worcester, Mass.
No. 13,104 Name John H. Greenleaf ~~Married~~ or Single
Address 76 Clover St.
Started Sept. 3, 1920
Trans. October 16, 1920
Left —
Rate 38¢
Age 19
Weight 156
Height 5' 8"
Ability Lathe & bench work. Fast and accurate
Brief History Weaving, Brown Woolen Mills 6 mo.
Monogram painting, Smith & Blake Co. 6 mo.
Grocery clerk, New York Store. 2 yrs.
High School 2 "

Fig. 2. Record retained by the Training Shop Office, giving Information relating to Each Man

Men with no previous experience are paid 38 cents an hour for the first six weeks, if single, and from 42 to 45 cents an hour, if married. If they have some previous shop experience they will be paid from 42 to 45 cents an hour, if single, and from 45 to 50 cents an hour, if married. The man who returns to the training shop for additional training on other machine tools receives a compensation equivalent to 15 per cent less than the hourly rate that he was allowed in the production department where he was last employed.

In addition to the training of young men hired for that purpose, the training department is also open to men already employed in the productive departments, who want to acquire additional training on other kinds of machine tools than those which they are operating. These men come into the training department on the condition that they receive 15 per cent less than their hourly rate during their training.

In unusual instances, when a man proves to have remarkable qualifications for learning and seems to possess such ability as to make it advisable to train him as fast as possible on all the different types of machine tools in the training shop, he will remain there continuously for twelve weeks, which is a sufficient length of time to give such a man a fairly good idea of shop work, under the intensive and systematic methods used.

It has not been found necessary to keep many records of the performance of the men in the training shop. The supervisor and the instructors are so closely in touch with the men being trained at all times, that very few written reports or records are kept. The only data retained by the office of the training shop is a record such as shown in Fig. 2, giving information regarding the more important facts relating to each man who passes through the department.

Cost of the Training Shop

The question that will be asked by every manager of a machine shop who contemplates the installation of a training shop will be, "How much does it cost to train an operator in this way?" It has been found at the Norton Co.'s plant that the cost of training a man for six weeks is $65. The actual full cost of the training averages $125, but the work turned out by the operator during the six weeks in the training shop is worth about $60, the difference—$65—being the actual cost to the company for the training of a competent operator. If this cost is compared with the cost of training a man in the shop departments, including all the spoiled work resulting from the first weeks of his employment, and the time taken by the department foreman in instructing him, it will be found that the training shop is by far the cheapest method by which a man can be trained. Furthermore, it produces a far superior working force, creates a better spirit throughout the shop, and is apparently the only solution to the problem facing manufacturers of obtaining skilled help without resorting to the practice—which in the end only proves a boomerang—of hiring skilled men from neighboring shops.

* * *

CAST IRON FOR LOCOMOTIVE CYLINDER PARTS

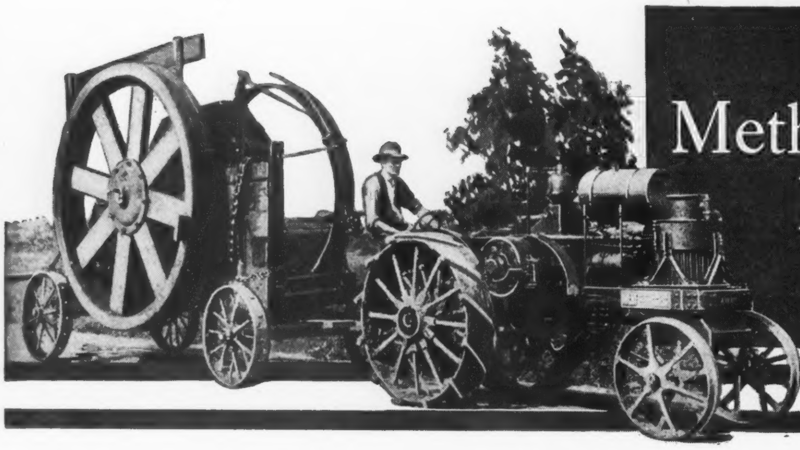
Frequent renewal of cylinder parts of locomotives results in greatly increased cost of maintenance to the railroads, and consequently the quality of the cast iron entering into their construction is a matter of paramount importance, particularly from the standpoint of wear. These parts include piston-valve bushings, piston-valve packing rings, piston-valve bull rings, cylinder bushings, piston packing rings and piston-head or bull rings. It was found that ordinary high-silicon cast iron gave unsatisfactory wear, particularly in modern superheater locomotives, and the tendency has been to use a harder and stronger iron.

At the request of the United States Railroad Administration, the Bureau of Standards has investigated the mechanical, chemical, and microscopical properties of a number of packing rings furnished with service mileage records, as well as arbitration-test bars, chill-test specimens, and miscellaneous samples from different manufacturers. All this material was cast iron such as is used for the various cylinder parts. The Bureau of Standards at the same time made a review of the previous work and specifications on this subject, to ascertain as far as possible the practice of the different foundries, and to suggest such revision of existing specifications as would be warranted by the results of the present and other investigations.

It was found that air-furnace iron is more uniform in character and in general of somewhat better mechanical properties than cupola iron. The latter, however, often equals or even excels the air-furnace product in mechanical properties. Because of the many variable factors, it was difficult to establish correlation between laboratory and service tests. It was recommended, as a result of the present and other investigations, that the transverse strength requirements of the standard American Society for Testing Materials 1¼-inch arbitration bar be increased from 3200 to 3500 pounds for castings ½ inch or less in thickness, and from 3500 to 3800 pounds for castings over ½ inch thick.

* * *

One of the results of the visit of the Swiss mission to the United States during the past year has been the formation of an organization designed to facilitate trade with the United States. This organization has headquarters at 8 Laupenstrasse, Berne, Switzerland, and its aim is to furnish exporters and buyers with any information that may be of assistance in furthering trade development between the two countries.



Methods in a Tractor Engine Plant

Special Machinery and Unusual Equipments for Standard Machine Tools

DURING recent years, much of the remarkable progress which has been made in the development of improved methods for the performance of machine shop operations and other lines of industrial work has resulted from a liberal interchange of ideas among men engaged in the same general lines of manufacturing. And in this connection, there is an important point to which attention should be directed, namely, the possibility of applying quite similar methods of conducting manufacturing processes and shop work in factories engaged upon the manufacture of widely divergent products. As a specific example, consider the work of the Avery Co.'s engine department in Milwaukee, Wis. This plant specializes on the manufacture of farm tractor engines, and for handling this work a number of unusually ingenious and efficient special machines and auxiliary equipments for standard machine tools have been developed for the performance of machining operations on engine parts. It would be reasonable to conclude that an equipment especially designed to meet the requirements of a shop engaged upon special work of this character would not lend itself readily to application in machining parts of other products; but as a matter of fact, there are a great many similar shaped pieces which enter into a variety of products, and similar methods could be employed on their production with desirable results. In studying methods in the Avery Co.'s plant, the aim has been to select for discussion only those which were felt to possess features which would make possible their application in a variety of industries.

In the series of articles, dealing with methods employed for the performance of production milling operations, which was published from April, 1919, to May, 1920, in MACHINERY, information was given in regard to various methods of milling cylinder blocks and heads for motor car engines. In all of the examples which were described, a practice was made of milling these parts on independent machines; but the production engineers of the Avery Co. realized that as there are no milling operations to perform on the sides of the cylinder blocks, and as the cylinder heads are thin so that they could be set in a vertical position and would occupy very little space, it would be entirely feasible to employ a multiple-spindle milling machine built by the Ingersoll Milling Machine Co., Rockford, Ill., and equip it with fixtures that would provide for holding the cylinder blocks in their normal position and the cylinder heads set edgewise in order to provide for simultaneously milling these two parts.

Fig. 1 shows the machine equipped for the performance of this operation, and reference to this illustration will make it apparent that the fixture holds the work for milling the crankcase side of the cylinder block and for milling the under side of the head that fits on the top of the block. So far as the actual design of this work-holding fixture is concerned, there is nothing particularly unusual in the method of locating and clamping the castings. It is the provision which has been made for holding the cylinder blocks and heads for machining them both at a single setting that is the noteworthy point. The possibility of increased efficiency in machining resulting from such a practice should appeal to the tool engineers in many plants engaged upon the manufacture of products in which there are similar parts to be milled.

It will be apparent that Fig. 1 shows a cylinder block set for milling the crankcase face *A*, while the cylinder heads *B* are shown held in an edgewise position on these same fixtures, to provide for milling the under side of the castings. At the same traverse of the milling machine table that performs these two operations, a milling operation is also performed on the head end *C* of the cylinder blocks that have been previously milled on their under side. This finished face of the work is used as a locating point, and it would be feasible to bolt the castings directly on the table of the machine, were it not necessary to elevate them to the same level as the castings which are set up for milling face *A*. This result is accomplished through the use of raising blocks *D*, the use of which will be clearly understood by reference to the illustration.

Fig. 1. Multiple-spindle Milling Machine equipped for simultaneously milling Avery Cylinder Blocks and Heads

Fig. 2 shows side and end elevations and a plan view of one of the milling fixtures for holding two cylinder blocks and two cylinder heads for the simultaneous milling of these parts. Referring to the plan view, it will be seen that there are three fixed points E_1 and three similar points E_2 against which the cylinder heads are pushed back, and the final location is accomplished by means of these points and three other fixed points F_1 and F_2. Clamping of the work in the fixture is accomplished by means of three set-screws G_1 and G_2 that secure the work against the fixed points F_1 and F_2. Bearing in mind that the plan view of the fixture shows provision for holding two cylinder blocks side by side for performing the first milling operation on the crankcase end of the work, it will be seen that there are three fixed points H_1 and three fixed points H_2 on which the two castings are dropped for a preliminary location. As this is the first cut taken on the work, it will be evident to experienced milling machine operators that the requirements of setting consist merely in providing a substantial foundation for the work during the period that the milling operation is being performed; then this milled face will be used as a locating point for setting up the work for performing subsequent operations. Each casting is lined up sidewise by pushing it against the heads of screws E_1 and E_2, which are allowed to project through the walls of the fixture for that purpose. Then the cylinder blocks are clamped down by means of bolts I_1 and I_2.

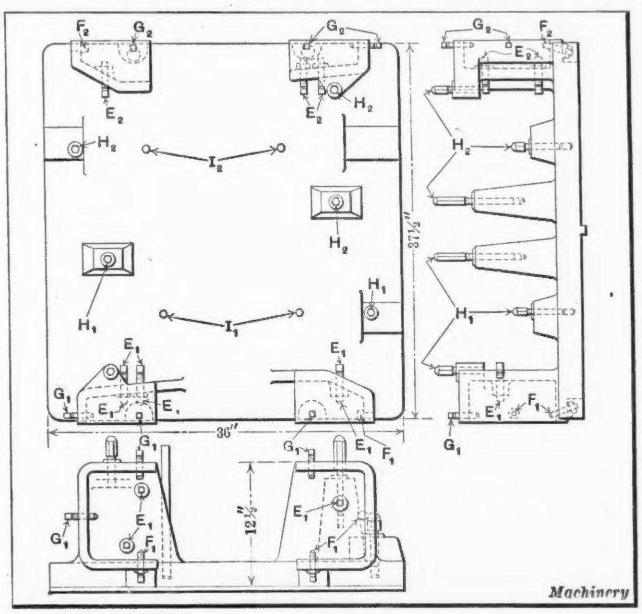


Fig. 2. Design of Work-holding Fixture used on Machine shown in Fig. 1

Special Drilling Heads for Use on Multiple-spindle Machines

For the performance of subsequent machining operations on cylinder blocks, the milled top surface *C*, Fig. 1, is utilized as a locating point. Fig. 4 illustrates a "Natco" multiple-spindle machine built by the National Automatic Tool Co., Richmond, Ind., which is employed for the performance of a drilling operation in the head end of the block. In this case, and for certain other multiple drilling jobs that have to be performed in the Avery plant, special drilling heads have been made to meet the requirements of operations where it is necessary to drill a number of holes on unusually close centers. Lower spindle members, of the type used on "Natco" drilling machines, were bought from the manufacturer, and special heads *A* were made to meet the requirements of each individual job. The spindles are permanently mounted in these heads, so that the entire outfit is kept in the tool-room as a unit and sent out to the drilling department when there are parts to be drilled of the types for which the special heads were made.

It will be seen that each spindle extends up to the point where the universal joint is located, and in setting up the machine for a job of this kind, the special head is secured to the main head by means of four bolts *B* fitting into the T-slot. Then the universal joints on the driving spindles are dropped into the corresponding members on the spindles of the special multiple head, and after setting up the drills, the outfit is ready for use. Mention was made of the fact that the previously milled head end of the cylinder block was used as the locating point for subsequent machining operations. In the present instance, it will be apparent that jig *C* is dropped into place over this finished surface and secured by means of set-screws. Otherwise, there is nothing that is particularly noteworthy in connection with this operation.

Fixture for Boring Cylinders Perpendicular to the Head End

Cylinders for Avery tractor engines are bored on the so-called "Hole-hog" type of machines built by the Moline Tool Co., Moline, Ill. Formerly, it was the practice to utilize the milled lower face of the block as a locating point for the performance of this operation; but for several reasons, it is more desirable to employ the milled head end for locating the work for boring the cylinders. To provide for performing the operation in this way, a fixture was recently designed which is shown in position on the machine in Fig. 5, while some of the details of the clamping arrangement are illustrated in Fig. 3. The purpose of this method of locating the work is to bore the cylinders exactly perpendicular to the milled top face of the block, and this result is accomplished by locating the casting against an upper finished face of the fixture and clamping it in that position. It is also necessary to have the cylinders bored in proper relation to other fixed points on the work.

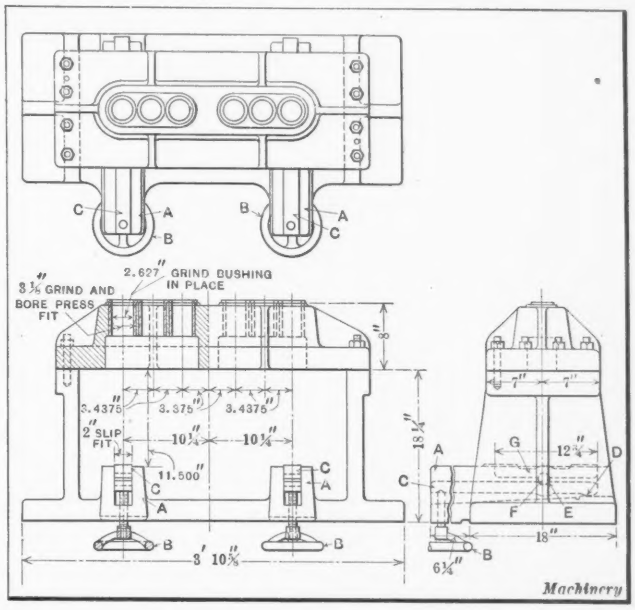


Fig. 3. Design of Work-holding Fixture used on Machine shown in Fig. 5

In starting to set up a casting in this fixture, it is lifted on the ends of rails *A* and slid forward. The milled top face of the casting is then raised into contact with the locating face of the fixture by turning handwheels *B*, which actuate elevating screws that lift two bars *C* located between the rails *A*, thus providing for forcing the casting upward. The best idea of the way in which this clamping mechanism on the fixture is operated will be gained by referring to the end view shown in Fig. 3, where it will be seen that at its forward end, each lift bar *C* has a shallow hole drilled to receive the point of the elevating screw that is turned by handwheel *B*. The weight of the casting holds the bar *C* firmly down on the screw point, and this engagement is depended upon to prevent the bar from shifting its position.

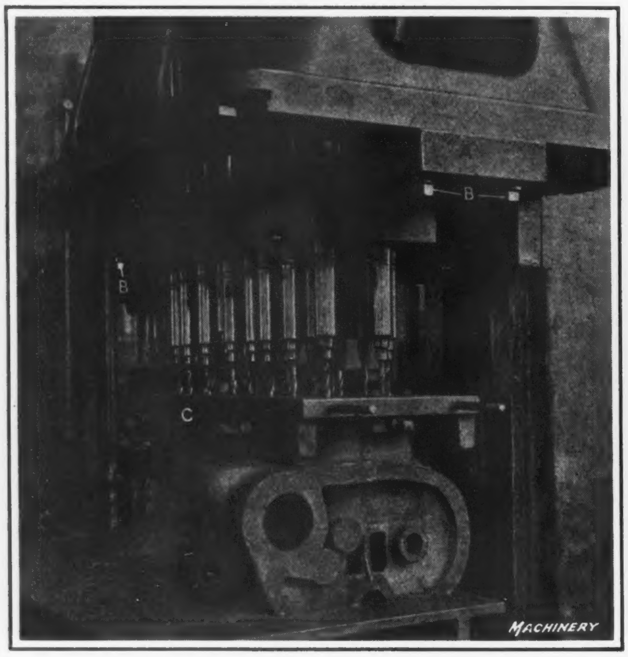


Fig. 4. Special Head designed for Use on Multiple-spindle Drilling Machine

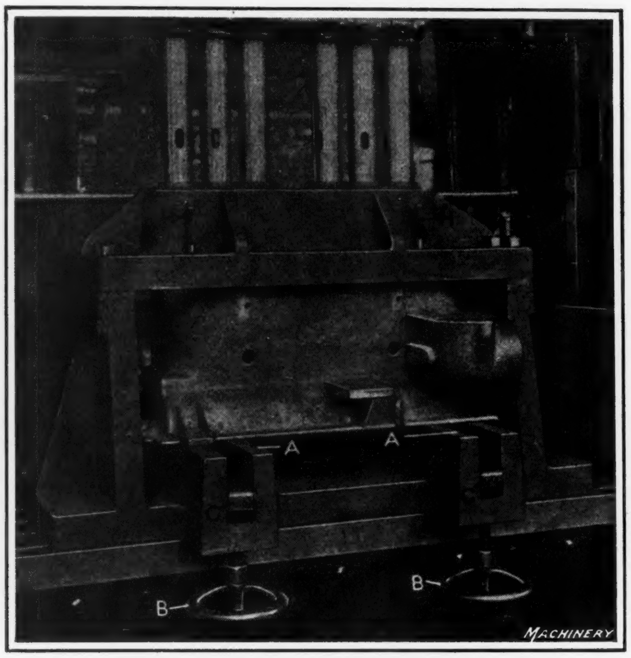


Fig. 5. Method of setting up Cylinder Blocks for boring perpendicular to Head End

At its rear end, each of these bars *C* is machined to a cylindrical form on its under side to afford a rolling action on a finished surface *D* on the bed of the fixture.

Near the center of each bar *C*, a semi-cylindrical shaped pocket *E* is machined to receive the under side of a roller *F*, and the upper side of this roller fits into a similar pocket cut on the under side of an equalizing clamping bar *G* which engages the bottom of the cylinder block that is to be bored. It will be evident that as handwheels *B* raise bars *C* the changes of angularity in these bars do not affect the clamping action on the work because the clamping bars *G* swing on rollers *F* and continue to apply a uniform pressure to the casting that will result in pushing its milled top surface tightly against the finished seat at the top of the work-holding fixture. After the casting has been placed in the fixture and before the clamping has been completed, two dowel-pins *H*, Fig. 5, are introduced into drilled holes in the top of the work to obtain the desired location of the bored cylinders relative to other fixed points. The milled top face of the cylinder block is also utilized as a locating point for the performance of the cylinder grinding operation.

Special Machine for Boring Combustion Chambers in Cylinder Heads

At *A* in Fig. 6 there is illustrated the head of a two-cylinder Avery tractor engine. For boring the combustion chambers in these castings, a special duplex boring machine has been built, which is illustrated in Figs. 6, 7, and 8. As the castings come to this machine they have been milled on their top and bottom faces, and they are dropped into fixture *B* on four fixed locating points, on which they are held down by the combined action of their weight and set-screws *C* that prevent the work from lifting. On the machine there are two tracks *D* on which the fixture *B* moves forward to provide for dropping the casting into place, after which the fixture is withdrawn to its position under the spindles for performing the boring operation in the combustion chambers.

The best idea of the way in which this special boring machine operates will be gathered by reference to Fig. 8, which shows the important parts of its mechanism in diagrammatic form. The drive is by means of a belt running over single pulley *F* and thence to a worm *G* on the horizontal driving shaft, that meshes with worm-wheels at the tops of the boring

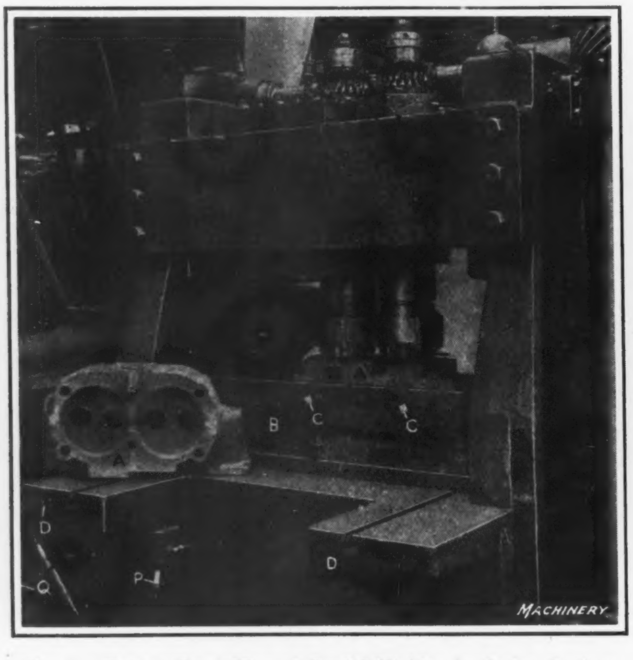


Fig. 6. Close-up Front View of Special Machine for boring Combustion Chamber in Avery Cylinder Heads

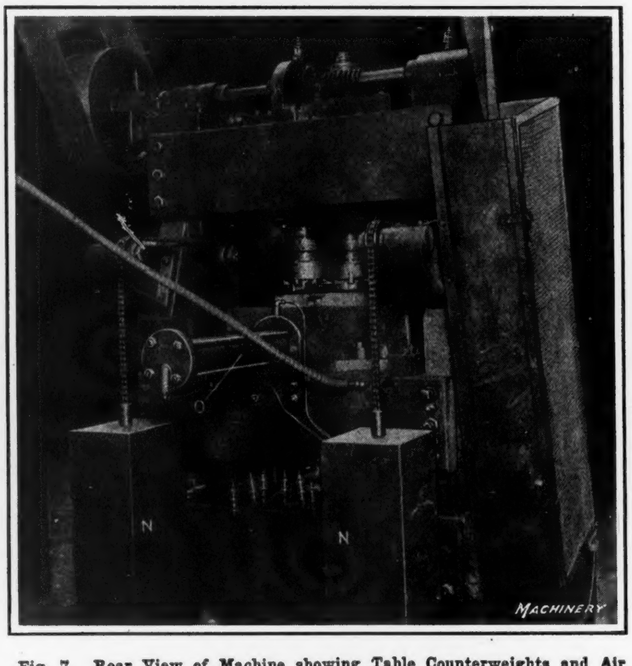


Fig. 7. Rear View of Machine showing Table Counterweights and Air Cylinder for Manipulation of Work-holding Fixtures

spindles *H*. From the horizontal driving shaft at the top of the machine, power is also carried down to the feed mechanism by a pair of spiral gears *I*, a vertical shaft and a worm and wheel *J*, and thence through a horizontal shaft carrying two worms that mesh with worm-wheels *K* which are threaded on vertical lead-screws *L* that are keyed to the table *M* of the machine to prevent them from turning. Worm-wheels *K* are free to turn, but are supported in such a way that they cannot move vertically; and as a result, the rotation of these worm-wheels threaded on the lead-screws *L* raises or lowers the table *M* according to the direction of rotation.

Referring now to the back view of the machine, Fig. 7, it will be seen that there are two counterweights *N* that balance the weight of the table so that the screws are merely required to overcome inertia and provide for feeding the work up to the cutters or withdrawing the table after the operation has been completed. The spindles *H*, Fig. 8, occupy a fixed vertical position and take no part in the feed movement, their function being merely that of rotating the boring tools. At the rear of the machine, Fig. 7, it will also be seen that there is an air cylinder *O* that is controlled by means of a lever *P* at the front of the machine, Fig. 6. This air cylinder provides for running the fixture *B* out for removing the bored casting and substituting a fresh one in its place, or for running the reloaded fixture back into position for performing the boring operation. After the boring operation has been completed, a clutch in the worm-wheel *J*, Fig. 8, on the feed-shaft is released, and a friction clutch (not shown) that is mounted on a pulley at the left-hand end of the horizontal shaft that transmits power to worm-wheels *K* on the elevating screws, is engaged by turning handwheel *R*, and provides for lowering the table to the starting position at a high rate of speed.

* * *

The Bureau of Foreign and Domestic Commerce of the Department of Commerce, Washington, D. C., has recently published a book entitled "Industrial Machinery in France and Belgium" for the benefit of American machinery manufacturers, engineers, and contractors interested in supplying the equipment necessary to rehabilitate the industries of the countries. The industrial needs of France and Belgium are classified, and industrial conditions after the war, as well as the application of American methods and credits in these countries are discussed. In a section devoted to trade methods, the markets available through France are given. Copies can be obtained from any of the bureau's district offices or from the superintendent of documents, Washington, D. C.

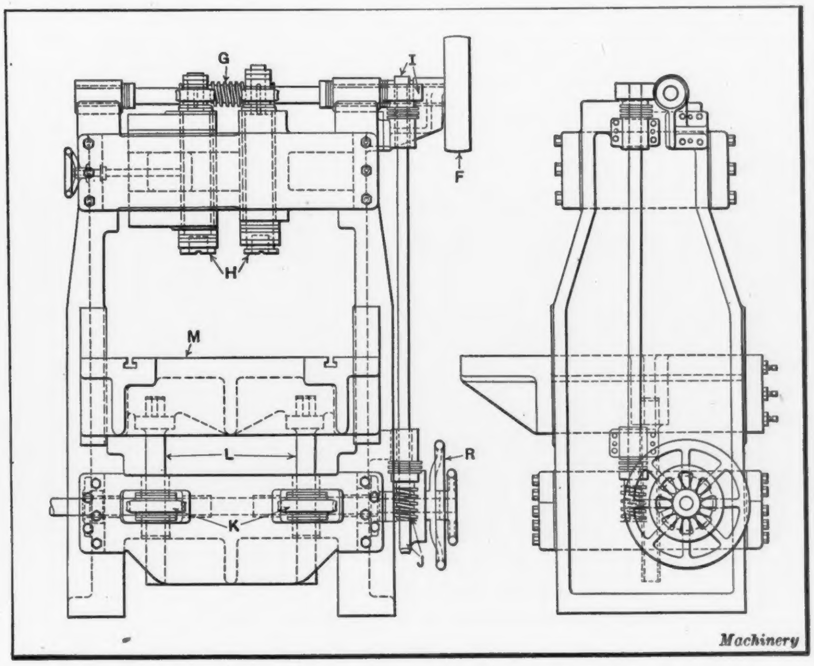


Fig. 8. Arrangement of Mechanism on the Special Cylinder Head Boring Machine illustrated in Figs. 6 and 7

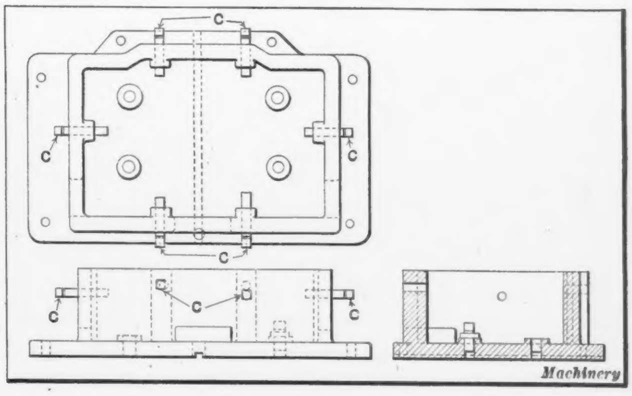


Fig. 9. Design of Work-holding Fixture used on the Special Cylinder Head Boring Machine

AMERICAN ENGINEERING COUNCIL

At the first meeting of the American Engineering Council, (the governing body of the Federated American Engineering Societies) recently held at Washington, Herbert Hoover was elected president of the federated societies. Delegates were present from twenty-one member societies, having a membership of over 50,000 engineers. Permanent headquarters are to be established at Washington, D. C. One hundred and sixteen organizations have been invited to become members of the federation. Of these thirty-five have definitely accepted the invitation, and a number of others are now merely awaiting formal action by their membership or governing boards.

* * *

INTERCHANGEABLE CONTAINERS FOR TRANSPORTING FREIGHT

A long step toward relieving the tense situation in the transportation lines of the country appears to have been made by the River & Rail Transportation Co. of St. Louis, Mo. This company has developed an interchangeable metal container, termed "Trinity Freight Unit," for facilitating the transfer of goods at terminals, as described by the *Railway Age*. Merchandise is placed in the container at a manufacturing plant or in a warehouse and then, locked and sealed, the container is transported by motor truck to a railroad, or to a waterway, where it is transferred to a flat car or to a boat without rehandling the materials.

The complete unit includes a specially constructed flat car, which differs from those now in use on the railroads of the United States only in providing a means of clamping the containers fast to the platform. Containers made in a number of different ways are provided for carrying various kinds of material. A type is designed with side-opening doors for package freight, another with top doors and drop bottom for loose bulk freight, and there are other types for refrigerator service and for carrying liquids. The units are made in capacities of 2½ tons and 10 tons each and are proportioned so that five 10-ton units, or twenty 2½-ton units, or several units of both capacities, and for any of the different classes of freight, can be carried on a flat car of 50 tons capacity. The system has already been tried and proved successful. The United States Railroad Administration adopted it to facilitate water-rail shipments of war supplies. Twenty of the 10-ton package units were built and gave satisfactory service in the New Orleans district in handling package freight. It is stated that estimates based on the performance of these units indicate that the handling of freight is greatly expedited, and can be handled at about 300 per cent less cost than with present methods.

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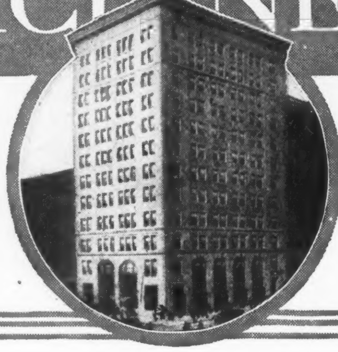

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COMMON CAUSES OF ERRORS IN MACHINE DESIGN

The many excellent articles and books dealing with the basic principles of machine design and manufacturing practice are almost indispensable to designers of mechanical apparatus, as they contain a vast amount of useful data, established facts, standard formulas and general information covering the important branches of engineering practice. But the young draftsman or designer soon learns that developing or originating various mechanisms is anything but a "cut-and-dried" process, and the facts and figures given in text-books, while helpful, must be so applied as to conform to the conditions affecting each problem in design. The endless variety of combinations and factors relating to work the mechanism is to perform, the conditions under which it must be used and the operating and manufacturing costs, must be considered in the design and tend to multiply the chances of drafting-room errors or the adoption of designs not representing the best practice.

The first of a series of articles on "Common Causes of Errors in Machine Design" is published in this number of MACHINERY and represents a careful study of drafting-room errors and their underlying causes, and gives some reasons why designs are not always what they should be. Draftsmen as well as experienced designers will benefit by studying these fundamental causes, which have been analyzed and recorded from the results of years of diversified experience. While all designers realize the importance of preventing errors as far as possible, the fact that they can be reduced to a minimum by a systematic study of fundamental reasons is not so generally appreciated as it should be. The general subject of errors in machine design will be treated in this series of articles from many different viewpoints, the assumption being that to neglect any element of design affecting operating results, manufacturing costs, quality of the product, or the reputation of the manufacturer, is an error. Another important point made is that draftsmen should not confine their efforts strictly to technical features, but should make a study of all factors which affect the commercial values of new or improved designs.

* * *

BALL BEARINGS FOR ELECTRIC MOTORS

With the increasing application of the electric motor drive to machine tools, the question of motor bearings is of great importance to the machine tool builder, because the motor virtually becomes part of his machine, and he, in a measure, is held responsible for its reliability. As any serious motor trouble will keep the machine idle, the continuous operation of the motor is one of the most important factors in the mechanical combination.

The electric motor of today is one of the most reliable mechanisms in general use, but there are opportunities for improving the mechanical features which merit more careful attention by electrical engineers. Those most familiar with the use of electric motors in the industries state that a great part of all motor troubles originate in the bearings, and that those troubles could be largely, if not entirely, avoided if electric motors were generally provided with ball bearings. In many instances, after difficulties with the bearings have developed, ball bearings have been used to replace the ordinary type, with very satisfactory results. The first cost is greater; but it is believed that the general application of ball bearings to electric motors would in the long run save the motor user several times the additional cost.

* * *

CONCERNING FIRE INSURANCE POLICIES

Owing to the high prices of labor and building materials, the average value of investments in industrial buildings has increased at least 100 per cent during the last five years, and the manufacturer faced with the necessity of increasing his plant soon learns how very much more it would cost to reproduce existing buildings than it cost a few years ago. Despite this fact, many manufacturers have overlooked the importance of increasing their insurance policies to cover replacements at present prices in the event of losses through fires. Those unfortunate enough to have had fires before taking such precautions have learned at high cost that insurance based on valuations of five years ago is entirely inadequate; furthermore, the co-insurance clause of the fire insurance policy makes it exceedingly risky not to carry full insurance. Bearing this in mind, factory owners who have not had occasion to look up their insurance for some time are advised to do so. Many will find that the amount of protection they carry on their property is inadequate to provide for replacement at present valuations. Building costs are not likely to come down for some time to come.

* * *

AN ENGINEER'S QUALIFICATIONS

The Carnegie Foundation for the Advancement of Teaching recently made a thorough investigation of many problems connected with engineering education. In the course of this investigation, questionnaires were sent to leading engineers throughout the country, asking them to state the characteristics which, in their opinion, counted for most in a successful career in the engineering profession. Over 6000 replies were received, and on a percentage basis the following qualities were considered the most important for a successful engineer: Character, 24 per cent; judgment, 19.5 per cent; efficiency, 16.5 per cent; understanding of men, 15 per cent; professional knowledge, 15 per cent; technique, 10 per cent. It is interesting to note that men who themselves have been successful in their profession considered general qualifications, such as character and judgment, to be far more important than mere professional knowledge and technique. Probably they had found it easier to acquire knowledge and technique than the other qualities essential to success in engineering.

Annual Meeting of the American Society of Mechanical Engineers

THE annual meeting of the American Society of Mechanical Engineers, held in New York City December 7 to 10, was marked by an unusually diversified program covering many different fields of mechanical engineering. Special sessions were provided by the Fuel Section; the Textile Section; the Sub-committee on Woodworking; the Machine Shop Section; the Management Section; and the Railroad Section. In addition there were two special sessions on design, two on research, two on transportation, a general session, and an organization meeting of the Ordnance Section.

Machine Shop Section

Three papers of unusual interest were read at the Machine Shop Section's meeting—one on "Side-cutting of Thread-milling Hobs," by Earle Buckingham, of the Pratt & Whitney Co., Hartford, Conn.; one on "Cylindrical Grinding in 1920," by W. H. Chapman, of the Norton Co., Worcester, Mass.; and one on "Mechanical Engraving and Die-sinking," by J. F. Keller, of the Keller Mechanical Engraving Co., Brooklyn, N. Y. Each of these papers was a distinct contribution to the literature of mechanical engineering, and recorded the results of years of investigation and study in different fields of theory and practice as applied to the machine shop.

Side-cutting of Thread-milling Hobs

It has long been known that, due to the helix of a thread, the side-cutting action of a hob distorts the form of the thread on the work. In other words, the form of the tooth on the hob is not reproduced on the threaded part. Mr. Buckingham's paper is the result of a mathematical investigation of this subject, and points out the corrections in the form of thread-milling hobs which can be readily made and which will produce threads sufficiently correct as to form for all practical purposes.

The profile of the thread cut with a hob is a combination of two distinct curves. First, a small fillet is formed at the root of the thread which is the path of the outside corner of the hob. No correction in the hob form can be made to rectify this. Second, the larger part of the flank of the thread consists of a slightly curved profile formed by the overlapping paths of the infinite number of cutting points which form the cutting edge of the hob. Mathematically, a curved correction can be applied to the form of the hob which will correct this profile entirely. Practically, a straight-line correction can be applied which is almost exact, as the amount of the actual curvature on the flanks of the thread is seldom greater than one-tenth of a thousandth of one inch. The greater the angle of helix of the thread, the greater the correction necessary.

One very interesting fact is that the diameter of the hob has no effect on the form of the main part of the profile. The actual amount of side-cutting is more, and the height of the fillet at the root of the thread is greater as the diameter of the hob is increased, but the rest of the profile is unchanged. The general conditions of side-cutting are identical in both externally and internally threaded parts. On a screw, however, the flanks of the hobbed thread will be convex, while in a nut they will be concave. Furthermore the height of the fillet at the root of the thread and the actual amount of side-cutting are relatively greater in a nut than on a screw.

Cylindrical Grinding in 1920

Mr. Chapman's paper comprises a study of the laws involved in cylindrical grinding and an analysis of grinding action (1) for draw-in cuts and (2) for traversed cuts. Grinding efficiency is usually considered as (production) ÷ (wheel wear). Accordingly formulas are derived for wheel wear in terms of grain size of wheel, work speed, wheel speed, feed, etc. By calculating values for wheel wear for different conditions and comparing them with production figures calculated under the same conditions, a proper selection of wheels can be made.

The fact that wheel wear is a comparatively unimportant item in the total cost of grinding, however, frequently leads to wrong conclusions if this is made the controlling factor. The all-important factor is the rate at which the wheel may be made to cut and still not get out of truth. It is shown that production efficiency is materially increased by increasing production at the expense of wheel wear within limits which are defined. The paper concludes with a discussion of production costs on this basis and with a series of practical conclusions, one of the most important of which is that increase of traverse speed increases production without increase of wheel-wearing action. These conclusions are given in full in the following paragraphs:

Conclusions Drawn from Investigation of Laws Governing Cylindrical Grinding

The greatest grinding efficiency is obtained by the use of the softest wheels suited to the nature of the material ground. This efficiency is dependent upon the control of the dimension and speed relations between the wheel and the work so that the individual chip may have the minimum depth for a given volume determined by the maximum allowable radial depth of cut. This means long arc of contact, low work speeds, and maximum feeds. With the above conditions established, increase of traverse speed increases production without increase of wheel-wearing action. The machine conditions must be such as to maintain as accurately as is reasonably possible the speed and dimensional relations of the wheel and the work. This includes a great number of factors, some of the most important of which are as follows:

The power drive must not allow speed variations unless under the control of the operator.

The wheel must be in good running balance and in absolute truth, and must be held in its position relative to the work within the closest possible limits.

The work must be accurately held with respect to the wheel and must be uniformly rotated. The relative traverse between the work and the wheel must be uniform.

The work must be rigidly supported over its entire length and no vibration allowed to occur between centers.

The feed control must be sensitive and accurate, and the feeding must be at a rate such that the feed increment never exceeds the maximum grain penetration. This is the most frequently violated of the factors involved.

The work must be kept at a uniform temperature and local heating prevented at all times. A copious supply of grinding compound should be directed to the arc of contact at all times. Eccentric work, due to bowing from heat effects, is the usual result of failure to supply sufficient compound at the arc of contact. In truing the wheel with a diamond, the use of the cooling medium is vital to accuracy. The diamond may be saved by using a dresser to true the wheel roughly, using the diamond only when necessary to put the wheel in exact truth for precision work. A diamond should never be fed over 0.001 inch per traverse. A single wheel should not be used for a variety of work sizes or ma-

terials unless the job is too short to warrant efficient grinding as compared with the time of changing wheels. Hard work (hardened steel, manganese steel, stellite, etc.) requires soft, rather fine wheels. The fine grain reduces the chip size but removes more chips, and the wheel wear is not so likely to cause a pounding of the wheel, nor will the small grains cause the glazing which is bound to occur with coarse, hard wheels.

An accurate finish requires the use of a soft, free-cutting wheel so controlled that the chips are very small (light feed and slow work speed with traverse to make the wheel face just cover the lead).

A burnished finish may be obtained by a peening action of a coarse, hard wheel trued dead smooth. Heating and inaccuracies of the surface are likely to occur.

Cases are rare where a wheel harder than grade M (Norton classification of grading) may be properly used in cylindrical grinding. Low wheel speeds, too small a wheel, too high a work speed and excessive feeding are usually the causes for the use of hard wheels. Mention should also be made of failure to take draw-in cuts to establish traverse limits, thus requiring too hard a wheel in order to make the "corner stand up." The designer and draftsman should not call for sharp shoulders where a generous fillet might be allowed. This makes needless difficulty in grinding and weakens the piece ground.

The contact of the wheel face with dry work at any time immediately ruins its value for finishing. The common practice of just touching the dry work when bringing the wheel to contact is wrong, due to the charging of the wheel face with the uncooled chips (loading).

When the machine is properly designed and operated, the grinding action will closely follow the theoretical law laid down in the first paragraph of these conclusions.

Mechanical Engraving and Die-sinking

In his paper on "Mechanical Engraving and Die-sinking," Mr. Keller reviewed the development of the art of reproducing designs from large models on a smaller scale, and the development of mechanical and automatic die-sinking machines by means of which dies are reproduced from models of the same size and shape. Numerous illustrations were shown indicating how this type of machine has been developed from the original simple form to a highly specialized semi-automatic or automatic machine that is capable of reproducing practically any form required for dies of various kinds. Some of the machines referred to have been previously described in MACHINERY in the article entitled "Mechanical Production of Drop-forging Dies," which was published in the September, 1915, number; in the article "Mechanical Die-sinking," published November, 1916, and in the article "Keller Universal Cutter and Tool Grinder," June, 1919.

Papers Read at Other Section Meetings

There were a number of papers read at the other section meetings that were of interest in the machine tool and the general machine-building fields. Among these may be mentioned several of the papers on design. One of these, entitled "Tests on Rear-axle Worm Drives for Trucks," by Kalman Heindlhofer, of the S K F Research Laboratory, Philadelphia, Pa., recorded a series of tests on worm drives used in the rear axles of motor trucks to determine the efficiencies under load variations.

An important paper by Louis Illmer, of the Southwark Foundry & Machine Co., Philadelphia, Pa., entitled "Experiences with Large Center-crank Shafts," described some disastrous experiences with a number of large gas-engine shafts of the center-crank type. Investigations as to the cause of the repeated shaft failures revealed inherent structural weakness due to defective design. The reinforcements undertaken to remedy this condition were based upon careful stress analysis of actual sag determinations conducted upon the shaft.

Rational Design of Hoisting Drums

Everett O. Waters, assistant professor of machine design, Yale University, New Haven, Conn., in "Rational Design of Hoisting Drums," called attention to the fact that the main problem of hoisting-drum design resolves itself into the determination of flange shape and thickness, and the determination of the thickness of the drum body. The correct proportioning of drum flanges is dependent upon the side pressure brought to bear against them by the coils of rope wound about the drum. In other words, flange thickness is a function of rope tension and depth of winding. Previous theoretical investigations have recognized these factors, but have failed to take account of the friction between adjacent coils of rope, and between rope and drum, which tends to hold the coils in position without the aid of the flanges, and have also disregarded the flattening of the inside coils under pressure from the outer layers.

The author has deduced a theoretical formula for the total pressure against a drum flange caused by the winding-on of rope to a given depth and under a given initial tension. Two other formulas are deduced, which relate this total pressure to the flange thickness and the maximum allowable tensile and shearing stresses in the material. By means of these formulas a flange of the usual straight-sided or the mushroom type may be designed to withstand safely the pressure of the rope wound upon the drum.

The drum body is subjected to combined stresses, since it is under compression from the coils wound upon it, under tension due to the lateral pressure against the flanges, and under combined torsion and bending caused by the load which is to be hoisted. Formulas are derived which may be used to obtain the correct thickness both at the center of the drum, where the normal stresses are greatest, and at the ends of the drum, where the shearing stresses are most prominent.

Foundations for Machinery

In a paper on "Foundations for Machinery," N. W. Akimoff clearly defined the purpose of building foundations, and showed that their purpose differed radically from that of providing substructures for machinery. Considerable contradiction can be found in blindly applying the principles of the former to the latter, and the results are sometimes so unsatisfactory as to necessitate the use of cushions and other yielding means, thus entirely undermining the very theory on which the foundation was supposedly built. Vibrations arise from either lack of balance or from other causes. The proposed theory contemplates the latter, the problem of balancing being considered as capable of complete solution by suitable treatment.

Flywheel Design

A paper was presented by R. E. Doherty and R. F. Franklin, of the General Electric Co., Schenectady, N. Y., on "The Design of Flywheels for Reciprocating Machinery Connected to Synchronous Generators or Motors." The results of an extended investigation are given as follows: (a) a complete solution of the problem of flywheel moment as related to the crank effort, synchronizing force and damping force; (b) modification of (a) for practical calculation; (c) a short method for determining the crank effort from the engine or compressor design; (d) practical method of determining the "initial angular deviation" from the crank-effort curve; (e) tests confirming the equations; and (f) discussion of the electrical forces involved and of the limitations which must be imposed upon power fluctuations.

Non-technical Sessions

The annual meeting was also marked by the important non-technical sessions held. A Brashear memorial meeting in memory of the late Dr. John A. Brashear, past-president of the society, was held at which an oration on "John Brashear as Scientist and Humanitarian" was delivered by Dr. Henry S. Pritchett. The Management Session was practically a memorial session in memory of H. L. Gantt.

Fluctuations in the Machine Tool Industry

An Interview with F. A. SCOTT, Vice-president, Warner & Swasey Co., Cleveland, Ohio

In the present interview Mr. Scott points out some definite reasons why prices in the machine tool industry must be maintained if the industry is to remain in a healthy financial condition. He shows why any reductions that may become economically feasible must be gradual, and dwells upon the fundamental differences between the machine tool industry—which makes a product that is not intended for immediate consumption but for producing other products—and the industries and commercial activities that have to do only with the production of articles for consumption. He makes a plea for the recognition of these fundamental principles in order that machine tool builders may be enabled to retain their organizations in times of depression so that they will be in a position to meet the needs of the industries in times of industrial and commercial expansion.

If a chart were made that would indicate the volume of business done in the machine tool industry over a period of years, this chart would show extreme conditions of activity and of depression. Were such a chart compared with one indicating general trade conditions, it would be seen that the differences between the high peaks and the low points are much greater in the case of the machine tool industry than in most other fields of industrial or commercial activity.

The reason for this may easily be found if the peculiar conditions surrounding the machine tool industry are examined. Machine tools are not bought for immediate consumption, as are food products or clothing; the commercial activities devoted to the latter products show, when charted, a comparatively even curve. Machine tools are bought as a capital investment, and hence find a ready market only in time of industrial expansion. When such an expansion takes place, the machine tool industry is exceedingly active, but when the period of unusual activity in the industries has passed, and especially at any time when there is a contraction or deflation of values, the machine tool industry experiences a dullness which frequently takes the form of depression. Yet, the machine tool industry is the basis of all other manufacturing industries, because the machine tool is used in making the machinery needed in every other industrial activity. If, because of its nature, it must experience severe fluctuations, the conditions surrounding it must be made such that it can survive these periodic depressions without too great an impairment of its organization and be ready to serve the commercial and industrial community again as soon as a period of expansion and capital investment makes this necessary.

The Present Period of Deflation and its Relation to the Machine Tool Industry

The present readjustment of prices and values is the real and permanent deflation that always follows the inflation of values during a war. The slight changes that took place immediately after the signing of the armistice were not due to real economic causes. Some price reductions were made at that time in the belief that just as soon as the war had ended, the readjustment, which everyone knew had to come sooner or later, would at once take place; but the readjustment at that time was based upon psychological factors rather than caused by economic forces. The changes that took place were due to beliefs and not based upon facts. The readjustment taking place now, however, is entirely different. It is based upon a definite economic law—the necessity for deflation of abnormal values.

During this period of deflation the machine tool industry must face a depression the same as most other industries; but the characteristics of the machine tool industry, as already explained, are such that machine tools will not be able to stand such a reduction in price as will take place in many other industrial products. The reasons for this are obvious to anyone who wishes to examine them. Before the war, machine tools were not priced anywhere nearly in proportion to their value as compared with the products of other industries. The evidence upon which this statement is based is ample. No great wealth, such as has been amassed in many other commercial and industrial undertakings, has ever been created in the machine tool industry. Even where prosperity is in evidence in this industry, it is a prosperity that has been due to the constant effort of two or more generations. Previous to the war, machine tool prices were practically never raised except when a new model was brought out. Yet, there was a gradual rise in costs and wages for a period of nearly twenty years previous to the war. The war brought about an increase in the prices of machine tools that was, in most instances, simply the normal increase that should have taken place previous to the war, and the increases, when compared with many other products, were moderate. The average increase, as shown by statistics compiled from the whole machine tool field, is not 100 per cent. In the same period many textiles, leather and food products increased in price from 200 to 400 per cent.

Reduction in Machine Tool Prices Must be Slow and Gradual

Any reduction that may take place in machine tool prices must be gradual. The machine tool industry differs from most other industries in that it cannot work off its raw materials and its inventory in a single season. In many cases the parts on hand will not be assembled into finished machines for a couple of years to come. Machine tool builders are not able to produce in great quantities like a maker of automobiles or sewing machines. This is one of the reasons why the makers of machine tools are generally referred to as machine tool "builders" rather than as machine tool "manufacturers." This industry must meet the constant requirements for improved types and has as yet had little opportunity to standardize and to profit financially by the production of standardized machines. On the contrary, profits have continuously been invested in development work and in the bringing out of new and improved machines and methods.

In view of all this, it is evident that the machine tool industry has no great surplus of war profits to draw upon to meet the present depression and cannot afford to make liberal reductions in prices while present inventories are on hand and present wages in force. Wages, as is well known, rise more slowly than prices, but they are also reduced much more slowly than other costs; and as wages are one of the greatest items of expense in the machine tool industry, because of the high proportion of skilled and experienced help required, there is no possibility, from an economic point of view, of reducing prices in view of the fact that a corresponding decrease in the cost of production has not taken place.

As regards raw materials, the coming year may see a decided reduction in pig iron, and this will naturally be

followed by a reduction in the prices of castings which constitute an important item in the machine tool builder's costs. But the advantage gained will not benefit the machine tool builder until his present inventory has been worked off, and this, with the present state of the machine tool trade will be a very slow process. As to steel, there is no reason to expect any material reduction from the base price now adhered to by the U. S. Steel Corporation, as this base price is generally considered to be as low as may be expected even with a considerable drop in pig iron prices.

Do Reduced Prices Stimulate the Machine Tool Market?

A decided price reduction in articles sold for immediate personal consumption may stimulate the market. The conditions are entirely different, however, in the case of machinery bought as an investment and for use in the production of other products. Machine tools are not bought because they are cheap. They are bought because they are needed to produce something else for which there is a demand. If there is no demand for this secondary product, there will be no demand for machine tools, and a sacrifice price would not make it advisable for the buyer to place an order, because a machine standing idle would be expensive at any price. On the other hand, when machine tools are needed in the industries, they will always find a ready market at any fair price, so long as they produce economically and advantageously. An intelligent buyer of machine tools does not buy on price but on quality. His selection is determined, not by the price, but by the adaptability of the machine to his purposes. The machine tool industry is not justified, by economic conditions, in reducing prices at the present time, nor would such a reduction be helpful in stimulating trade.

It has been pointed out that the present machine tool prices are lower than those of other products when compared with the pre-war prices, and the fact has also been emphasized that the pre-war prices were lower than justified by a healthy financial condition of the industry. It may also be said that in buying a machine tool the purchaser receives a greater definite value for his money than in buying practically any other article on the market, with very few exceptions. The average machine tool has a useful life longer than that of most other manufactured articles or devices. For fifteen or twenty years it will continue to turn out products for the purchaser, and in many instances will enable the original capital investment to be regained many times during the life of the machine. A product having such valuable characteristics should and must be so priced that the industry producing it is enabled not only to weather the periodic depressions that in the very nature of the industry it will be expected to encounter, but also to develop and expand so that it may, in ever-increasing measure, contribute to the general industrial advance of the country.

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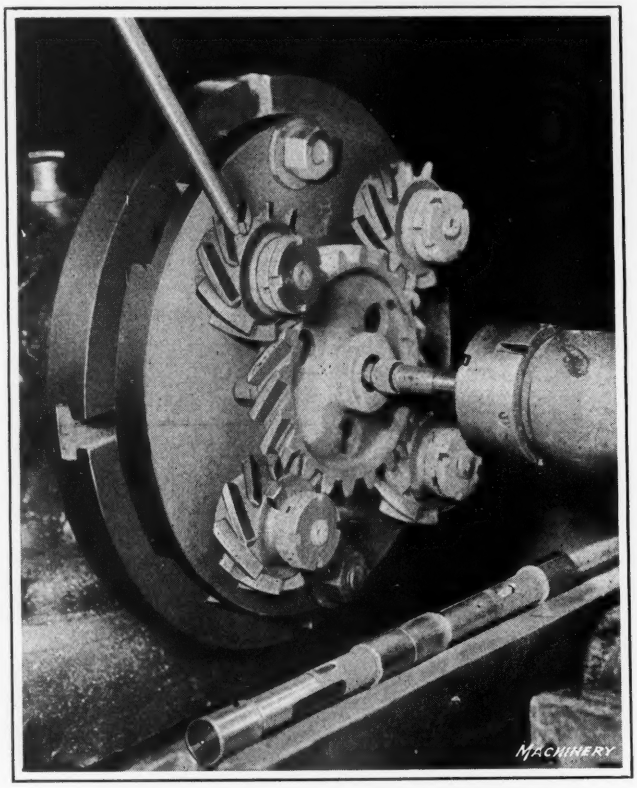
BRITISH RESEARCH ASSOCIATION

A research association for the gray and malleable cast iron and allied industries has been organized in England, and is the second trade, in which Birmingham is greatly interested, to take advantage of the government offer of one million sterling, to be placed at the disposal of the research committee. Up to the present time no fewer than eighteen trades have taken advantage of this offer, and five others have been approved and will shortly receive licenses from the Board of Trade. This effort to bring science into closer relationship with industry is, needless to say, the outcome of war experience, when the best brains of the country and the resources of the laboratory were called upon either to expedite or originate production. In addition to promoting research and disseminating information, the association will foster education and do all it can to make foundry life more hygienic.

GARRISON SPIRAL GEAR CHUCK

In the article on "Cadillac Grinding Practice," published in October MACHINERY, a No. 75 Heald internal grinding machine equipped with a chuck for holding spiral gears while grinding the bore was shown in Fig. 3, page 105. This chuck comprises principles which are covered by patents owned by the Garrison Machine Works of Dayton, Ohio, who manufacture a chuck for the work described in the Cadillac article, and we regret that no mention was therein made of this fact, as it was not known to the author at the time of writing the article.

The Garrison chuck is a practical and ingenious device for holding a gear from the pitch circle during the performance of grinding and other similar operations. For such work, accuracy of the diameter of the ground hole is valueless unless the hole is concentric with the pitch circle of the gear, rather than with the outside circumference. As the pitch circle of a gear is the point from which computations are made for manufacturing and for determining the center distance between two gears, this is a logical point from which to locate gears when chucking for the performance of any operation that is required to finish the bore or any other



Spiral Gear Chuck made in Accordance with Principles covered by Patents owned by the Garrison Machine Works

surface concentric with the pitch circle. This method of chucking insures concentricity of the bore with the pitch circle, regardless of errors produced in turning the blank or resulting from inaccurate mounting of the work on the arbor of the gear-cutting machine. Accuracy of the grinder chuck is of unusual importance, owing to the fact that it is usually employed for performing the last operation, and if inaccurate it will adversely affect all previous work, even though this work has been properly done. Patented chucks are made by the Garrison Machine Works for holding other types of gears in addition to the spiral type shown in the illustration.

* * *

The value of metal-working machinery of all kinds exported from the United States to Sweden during 1919 amounted to about $850,000, of which about $450,000 was represented by machine tools. In 1920 the figure for all metal-working machinery was about $460,000 and for machine tools about $300,000.

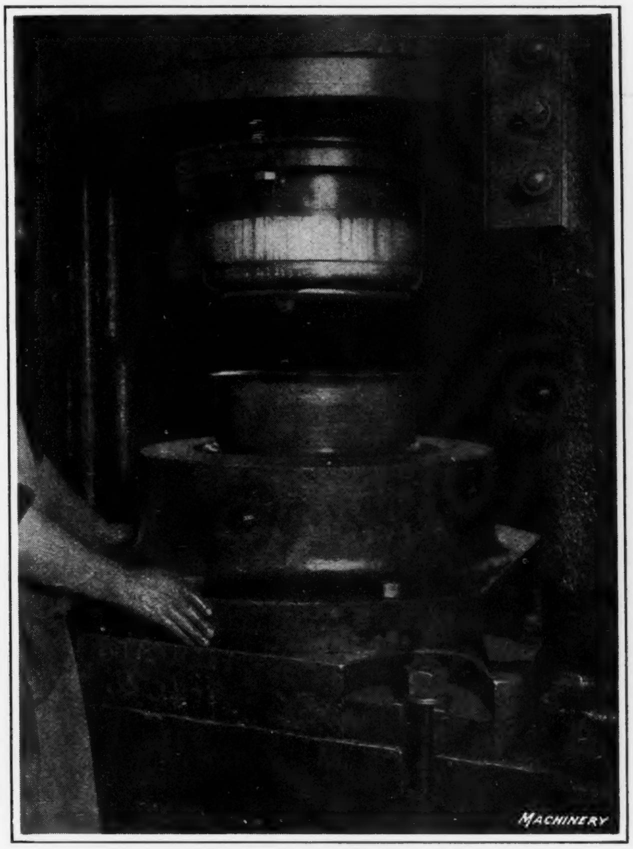


Fig. 1. Double-geared Power Press equipped for performing Third Operation on Seamless Kettles

Fig. 2. Bulging Operation performed hydraulically on a Press equipped with a Split Die

Drawing Operations on Seamless Kettles

Design of Dies and Step-by-step Operations in Making a Difficult Drawn Shape

By FRED R. DANIELS

KETTLES containing no seams, corners, or crevices in which particles of foreign substances can collect, and which are shaped to eliminate all splash resulting from pouring liquids into them, require in their manufacture a variety of interesting drawing dies. Figs. 6 and 9 show a kettle of this type made by a large manufacturing concern.

The material from which these kettles are made is No. 18 gage sheet steel, and the pieces from which they are drawn are about 24 inches square. The first operation consists of blanking and drawing, and this work is performed on a Toledo toggle press. The second and third operations are drawing operations in which the depth of the shell is grad-

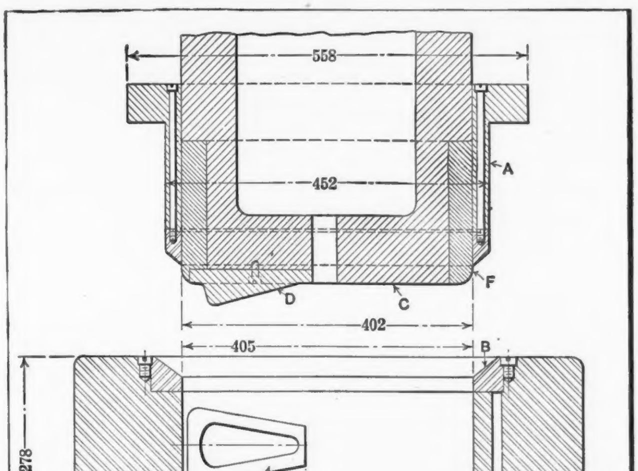


Fig. 3. Punch and Die employed in the Third Operation in the Manufacture of Seamless Kettles

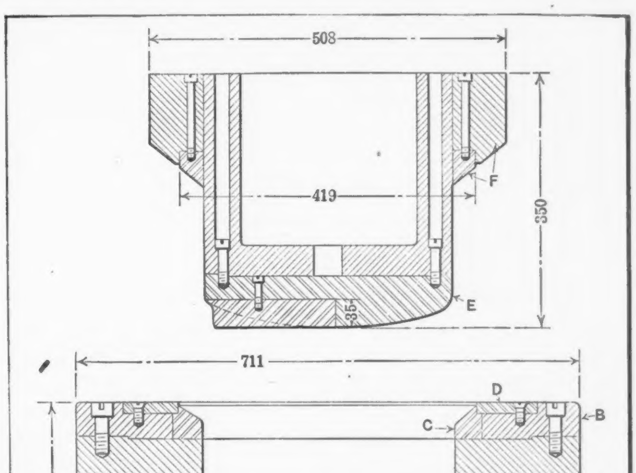


Fig. 4. Punch and Die used in rounding the Bottom and partially forming the Drain Spout Gutter

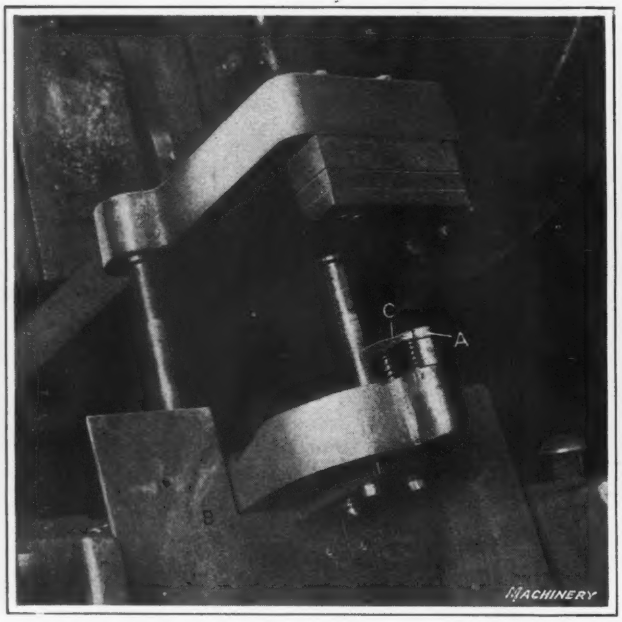


Fig. 5. Inclined Press and Equipment for piercing Hole for Faucet

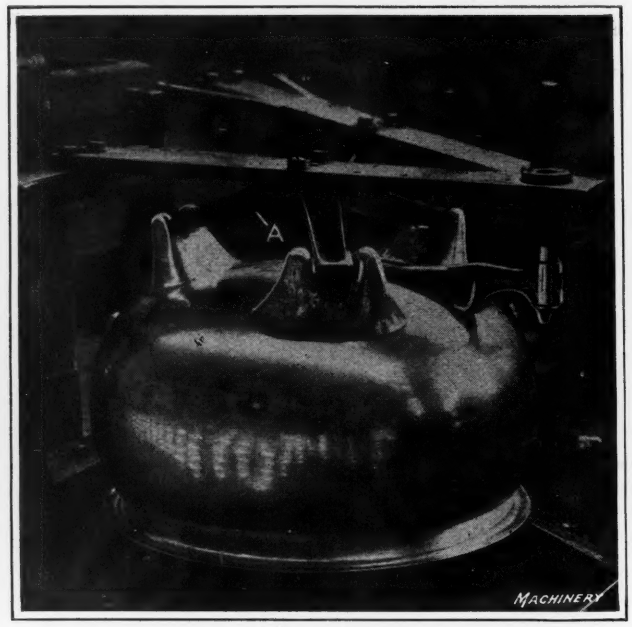


Fig. 6. Locating Jig employed in assembling the Legs and Faucet

ually increased to produce a straight cylindrical form. The punch and die used on Operation 3 is illustrated in Fig. 3, and the set-up of the machine with the work in place, in Fig. 1. Referring to Fig. 3 it will be seen that these dies are of the double-action type, and that the blank-holder *A* holds the top of the work against the die ring *B*, while punch *C* enters the die and draws it to the approximate depth and shape indicated by the proportions of the die. Carried in punch *C* is an auxiliary punch *D* for forming the drain spout gutter in the kettle. The die used to form the gutter is shown at *E* and is set into the knock-out plate *G* as shown. Punch *C* is provided with a sleeve *F*, which may be replaced when the diameter becomes worn sufficiently to need attention. The kettles are next annealed in special sheet-steel covered cans at a temperature of 1350 degrees F. for a period of one hour and cooled, after which they are placed in the die illustrated in Fig. 4, for the purpose of rounding the bottom of the shell and forming the drain spout gutter approximately to its final shape. This die is used on a Toledo No. 59½ toggle press. The essential parts of the punch and die are the die-block *A* to which the die-ring holder *B* and die-ring *C* are attached; the die ring *D* for trimming the shell; the punch *E*; and the flange punch and holder *F*. These tools are also provided with the same general type of auxiliary punch and die for forming the drain spout gutter as employed in the performance of the third operation.

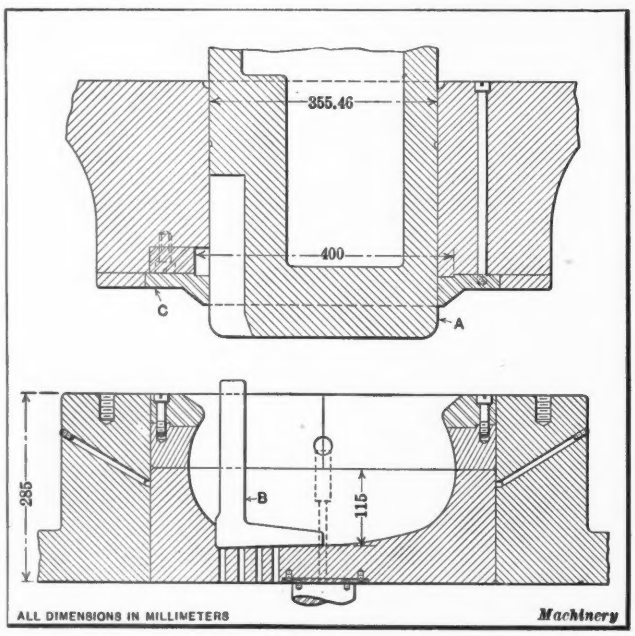


Fig. 7. Sectional View of the Bulging Die shown in Fig. 2

The seventh operation is a bulging operation and is performed hydraulically on a No. 157½ Toledo toggle press, as shown in Fig. 2. This illustration shows the change which occurs between the previous drawing operation and the bulging operation. By referring to this illustration in connection with Fig. 7, which shows a sectional view of the punch and die, a good idea of the functioning of the tools and their construction may be had. The upper portion of the die, as Fig. 2 clearly shows, is made of two parts, which are matched together by half-holes that fit pin *A* in the die-block.

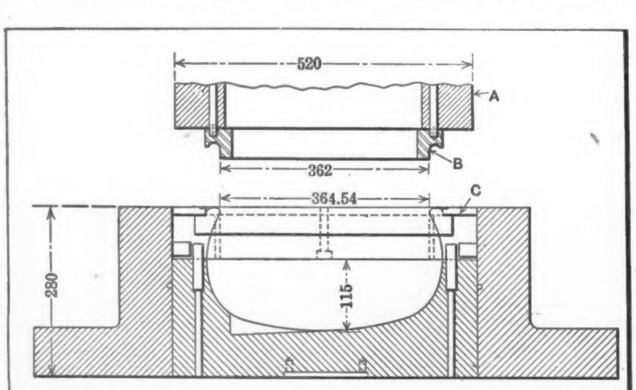


Fig. 8. Punch and Die used in curling the Top of the Flange and trimming its Edge

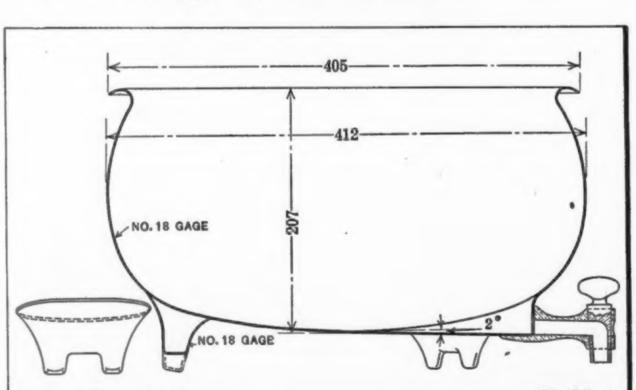


Fig. 9. Sectional View of the Seamless Kettle with Legs and Faucet assembled

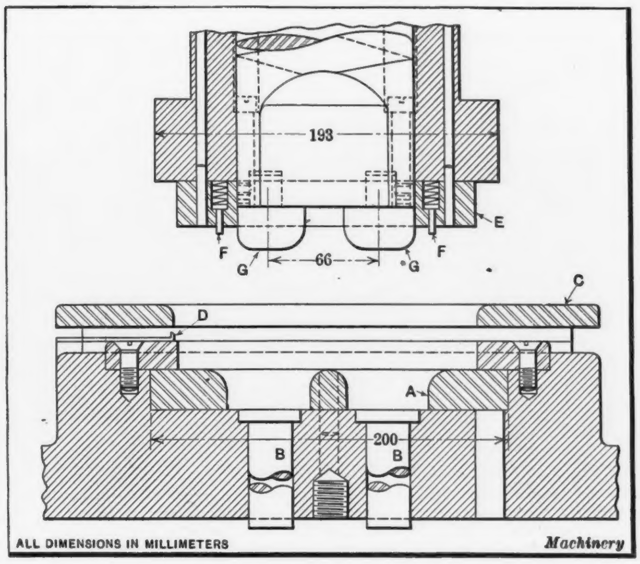


Fig. 10. Punch and Die used in the First Operation on the Kettle Legs

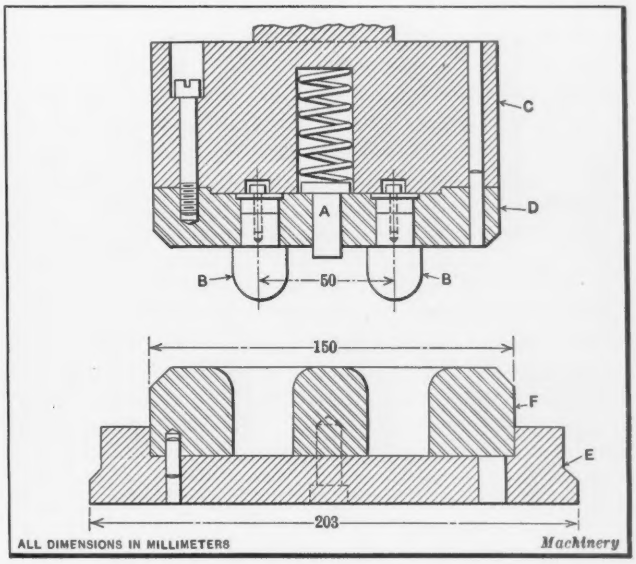


Fig. 11. Punch and Die used in the Fourth Operation on the Kettle Legs

This operation is performed in the following manner: The operator fills shell *B* with water from tank *C*; the shell is then set in the lower part of the die, and the two halves of the upper portion of the die are placed around it so that as punch *A*, Fig. 7, descends, carrying blank-holder ring *C*, it will compress the water and bulge the shell to the shape of the dies. In this operation a special drain spout gutter former *B*, also shown at *D*, Fig. 2, is placed in the work, to maintain the shape of the gutter during the bulging operation. A part of the punch is cut out to enable it to pass down over the gutter-former without disturbing its position in the shell. This is a double-action press, and the punch and die operates on the same general principle as that employed in other double-action drawing dies.

The eighth operation consists of curling the top of the flange and trimming the edges. The equipment used is illustrated in Fig. 8, *A* being the punch-holder, *B* the curling and trimming punch, and *C* the die ring. This die is necessarily, on account of the bulged shape of the work, of two-piece construction. The tools are used on a No. 59¼ single-action Toledo press.

Burring Edge of Kettle and Punching Hole for Faucet

In Operation 9, the edge of the kettle is burred, the work being mounted in a Prentiss lathe fitted with an expansion air chuck. Operation 10 is that of punching a hole for the faucet in the end of the projection formed for the drain spout gutter. This is done on the No. 6½ Toledo inclined press illustrated in Fig. 5. The kettles are placed over punch *A*, and rest against the plate *B* in such a position that when the ram of the press descends, spring-stripper *C* will be depressed, and on the upward stroke of the ram the stripper will force the work up until the punch, which is the lower tool in this case, has been withdrawn. The ends of the gutter, after this piercing operation, are then squared up and the hole shaped to conform to the shape of the faucet. This is also done on an inclined Toledo press equipped similarly to the press employed in punching the hole. The kettles are now ready to be cleaned, tinned, and polished preparatory to assembling the legs and faucet, which have been similarly treated.

Dies for Forming the Kettle Legs

The construction of the punches and dies used in the several operations necessary to shape the kettle legs may be understood by referring to Figs. 10 to 18 inclusive. The first operation on the legs is performed in the dies shown in Fig. 10. In this connection reference should also be made to Fig. 6 and to Fig. 9, where in the lower left-hand corner, the shape of the finished legs may be seen. In the fabrica-

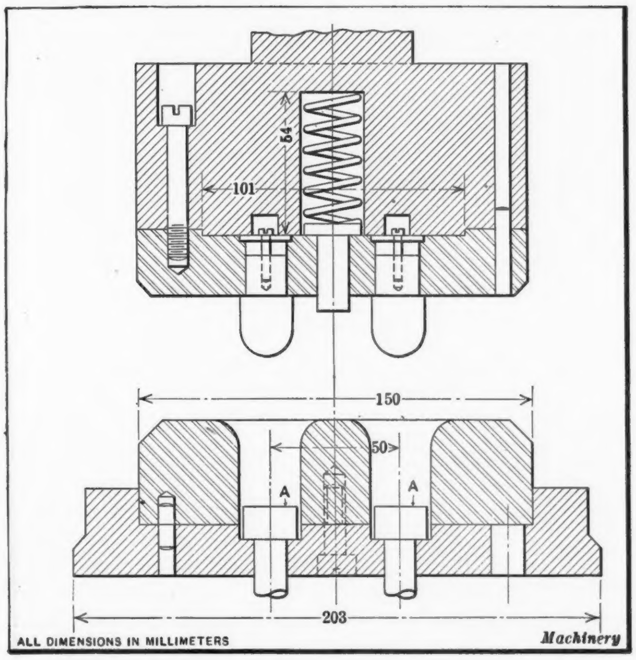


Fig. 12. Punch and Die used in Fifth Operation on the Legs

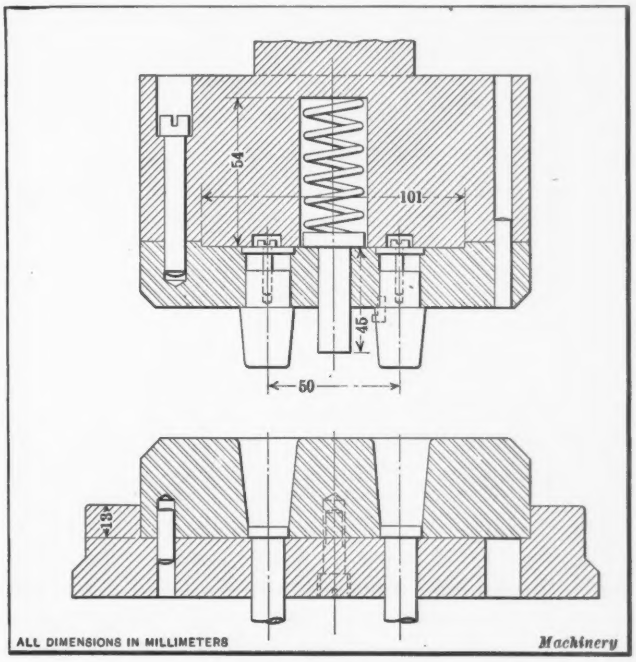


Fig. 13. Dies for producing First Taper on the Legs

tion of the legs, the feet are first formed in the double forming die *A*, Fig. 10, which is provided with two knock-out pins *B*, operated by a spring buffer of familiar construction. The legs are made from strip stock which is fed under stripper *C* and against stop *D*. It will readily be seen that this is a combination blanking and drawing die, and that blanking punch *E* carries two spring stripper pins *F* for forcing the work from the forming punches *G*.

The dies used in the second and third operations are so similar to those employed in the fourth operation that no reference to these dies need be made. Referring now to the fourth-operation dies shown in Fig. 11, it will be seen that this is a straight drawing operation and that the tools are employed in a single-action press. The upper member is equipped with a spring stripper *A* for removing the work from the punches *B*. The punch-block *C* and die-block *E* are made of cast iron, and the punch-holder *D* and die ring *F*, of hardened tool steel.

Fig. 12 shows the tools used in performing the fifth operation. These tools are of essentially the same design as those just described, but in addition the die is provided with a

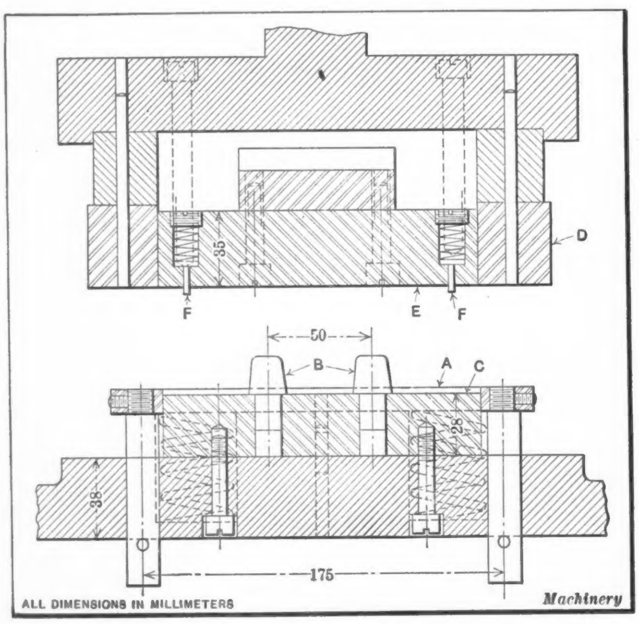


Fig. 14. Punch and Die which starts the Draw on the Upper Part of the Legs

knock-out device, the two pins of which are shown at *A*. The punch and die used on the sixth operation will be seen in Fig. 13. The punches used in this operation are tapered, whereas those used in the preceding operations are straight. A knock-out is provided for both the punch and the die, as in previous constructions.

Drawing Operations on Upper Part of Legs

In Fig. 14 the punch and die used in performing the first drawing operation on the upper part of the legs is shown. This is the seventh operation on the parts, and in it the work is placed on the spring-supported stripper plate *A*, located by the two guide pins *B*. These guide pins are carried in die *C*. The punch *D* is made of tool steel, and carries a stripping mechanism consisting of block *E*, in which the two stripper pins *F* operate. In operation, the punch *D* descends on the flat part of the work which rests on stripper plate *A* and draws the legs at a 90-degree angle over the edge of the die. On the upward stroke of the press ram, strippers *F* function and prevent the shell from adhering to the punch. At the same time stripper plate *A* lifts the drawn shell from guide pins *B* so that it may be readily removed from the die.

The punch and die used in the second drawing operation on the top part of the legs (Operation 8) is illustrated in Fig. 15, and the shape to which the work is drawn may be seen by inspecting the shape of the punch *A*. It will also be

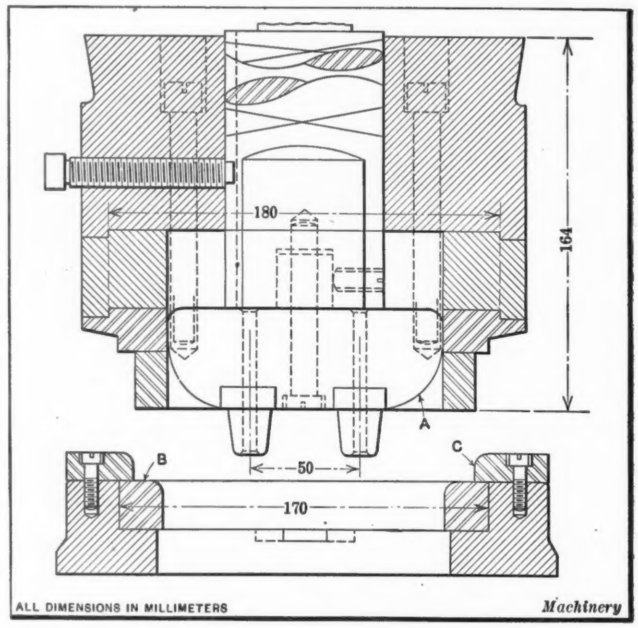


Fig. 15. Tools used for Second Drawing Operation on the Upper Part of the Legs

seen that the shape produced in the dies for the seventh operation is such as to enable the work to rest on die *B* and be located within the die ring *C*. The ninth operation shapes the feet to the approximate shape shown by die *A*, Fig. 16. This punch and die is used on a single-action press, the punch member being provided with a knock-out *B* operated by stripper bar *C*.

Operation 10 forms the legs to practically the finished shape, and the tools employed in this forming operation are shown in Fig. 17. It will be noted that two knock-out pins *A* are provided for the two feet, these being operated against spring pressure by means of a knock-out plate, located below the die-block (not shown in the illustration). The punch follows the general design of the preceding punches, and carries the customary knock-out rod or stripper.

In order that the legs may fit the curvature of the kettle and seat evenly, the punch shown in Fig. 18 is employed to produce the same curvature for the top of the legs. It will be seen that the tool-steel forming member *A* is of simple design and that the cast-iron die-block is sunk to receive the

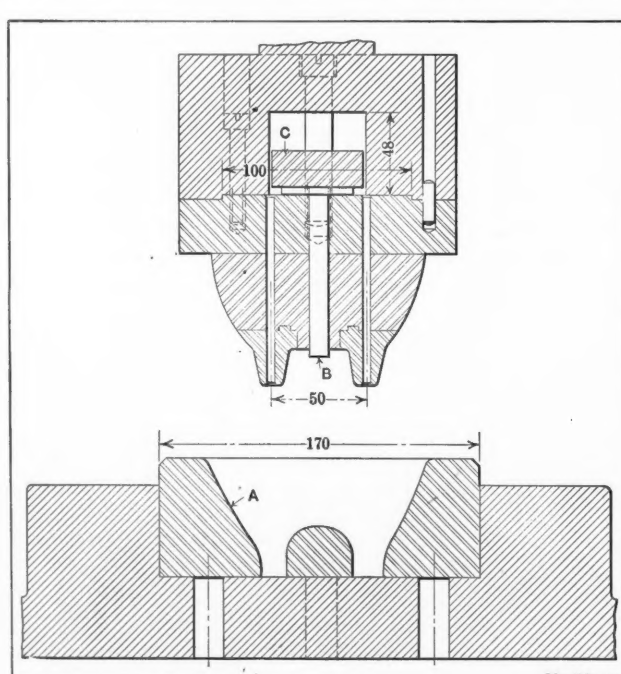


Fig. 16. Tools used in the Ninth Operation for forming Legs to Shape shown by Punch

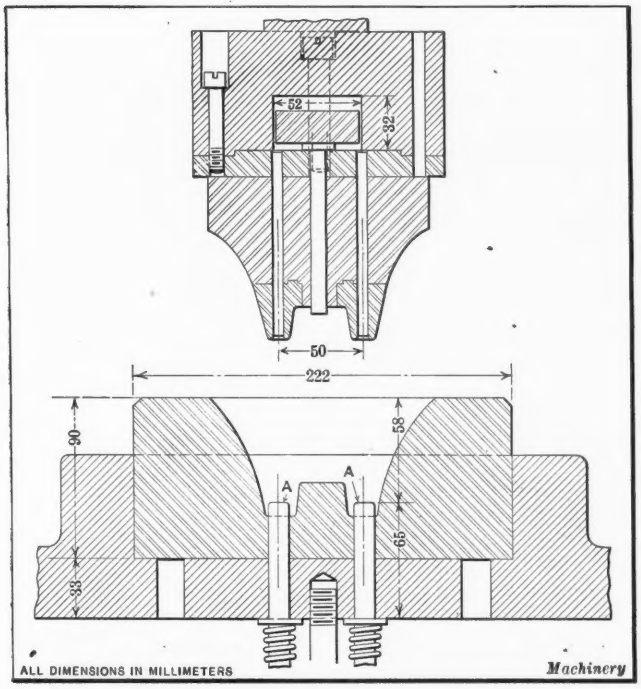


Fig. 17. Dies in which the Legs are formed to approximately the Finished Shape

formed leg. The machine steel knock-out *B* is offset from the center of the die a sufficient amount to overcome the lack of symmetry in the shape of the leg, and to enable one knock-out to eject the parts, instead of requiring two.

Assembling the Legs and Faucet

The work of assembling the legs and faucet is performed on one bench, the work passing from one end of this bench to the other, at which time the legs are correctly located, and securely fastened. Fig. 6 shows the first operation in assembling. A spider *A*, which is a counterpart of the bracket on which the kettle is supported when in use, is employed to locate the legs accurately on the bottom of the kettle. The arm of the locating fixture which carries this spider has a suitable plug to fit the hole in the faucet, which is previously set into the pierced and formed hole in the end of the drain spout gutter. With the three lugs and the faucet held in this position, the operator tacks them in position with solder, and then removes the fixture from the work, which is then passed along to the next workman who finishes the soldering operation. Finally the kettles are tested for leakage and are hand-polished and given a thorough visual inspection.

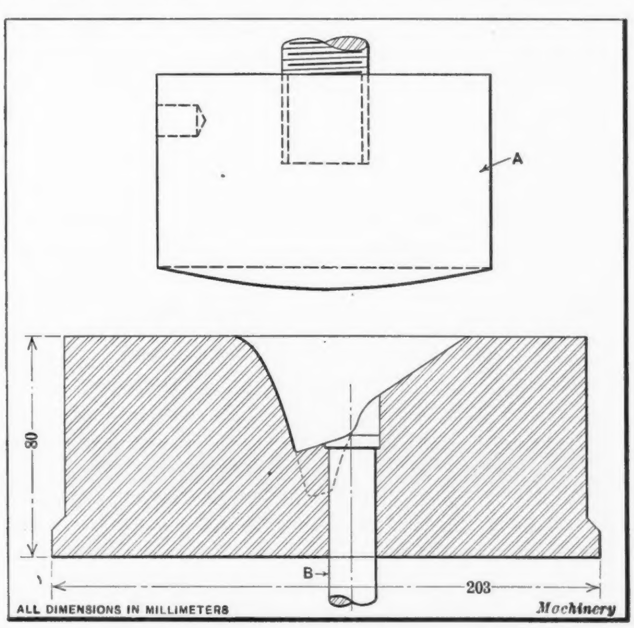


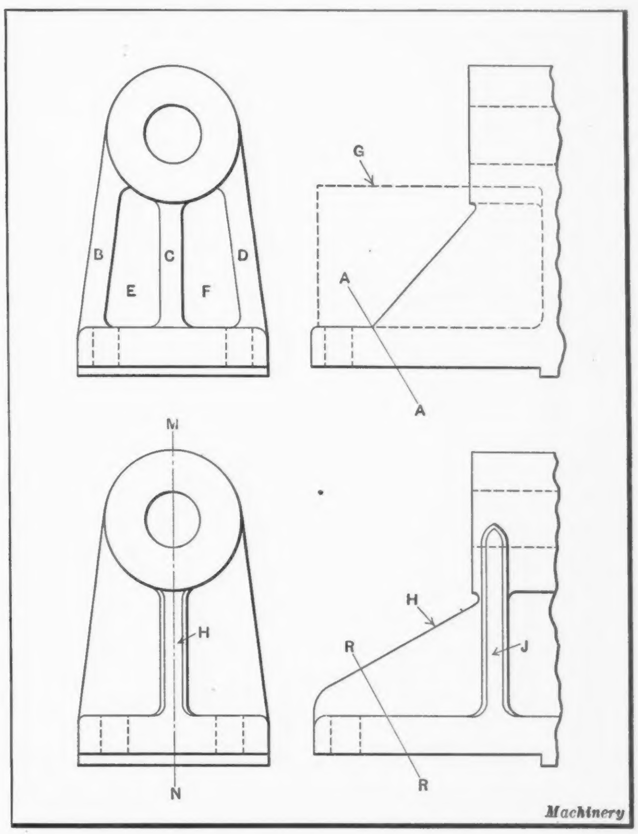
Fig. 18. Final Operation—Shaping the Upper Edge of the Kettle Legs

SIMPLIFIED PATTERN FOR QUICK REPAIR JOB

By M. E. DUGGAN

In replacing broken machine parts, it is sometimes possible to improve on the design of the original part so that its efficiency is increased or so that it may at least be made much quicker than if an attempt were made to produce an exact duplicate of the original part. The following example of a repair job which had to be done in a hurry is a typical illustration of what may be accomplished along these lines by a patternmaker when called upon to make patterns for the replacement of broken cast-iron parts.

The design of the casting that broke is shown in the upper view of the accompanying illustration. The break was along line *AA* which shows that this section was too weak in proportion to the strength of the ribbed section. It is evident that ribs *B* and *D* are unnecessary and that the strength of the casting will be more uniform if only one rib *C* is employed. As the pattern for the original casting was lost, the pattern-

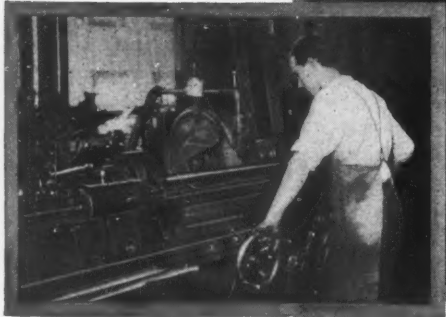


Cast-iron Bracket which broke at AA, and Bracket as redesigned

maker was called upon to make a new pattern. He saw at once that to follow the original design would mean spending considerable time constructing a core-box for a balanced core *G* which would be required to form the pockets *E* and *F*. He also knew that molding and casting would be greatly expedited by making the pattern with only one rib, as shown in the lower view. By tapering ribs *H* and *J* to make an easy "cope" lift, it was possible to make the pattern in one piece and thus save considerable time. Ordinarily, however, when time is not so important a factor, the pattern would be split through the middle on line *MN*. It will be seen that rib *H* extends down to the end of the casting base, thus giving greater strength through section *RR* which corresponds to section *AA*, where the original casting failed.

* * *

Painting safety guards on machines in a bright color has a psychological effect on the operators, for if a guard should be out of position it becomes very noticeable. The guards are not as likely to be left off the machine in this case, as they advertise the neglect of the men.



Work Speeds in Cylindrical Grinding

Showing the Fallacy of the Idea that the Faster the Rotation of the Work, the Higher the Rate of Production

By ROBERT J. SPENCE

CYLINDRICAL grinding machines are furnished with means in the headstocks for obtaining a range of work speeds. This variety of speeds is provided, the same as on other machine tools, for the purpose of accommodating the speed of the work to the action of the cutting tool. In most machine tools the work speeds usually advance in steps, from the slowest speed to the fastest, in geometrical progression. This scheme permits an accumulating increase in momentum from each speed to the next higher in the series. The grinding machine usually has a change from one work speed to the next in a ratio of about 1.2 to 1—a trifle less for the slower speeds and a trifle more for the faster ones. This gives a satisfactory, gradual increase from the slowest work speed, which is supposed to accommodate the relatively fast surface speed of large-diameter work, to the next work speed, without too radical a change. Yet, at the same time, this ratio makes a sufficiently increased gain in speed for work of small diameters where a decided increase in work speed is required when a change is made from one small diameter to a still smaller size.

Why Unsuitable Work Speeds are Often Used

The importance of the function of the speed-changing device does not seem to be understood in general by operators of grinding machines. In fact, it is seldom that an operator is found who appreciates the full value of the means at hand whereby he can, as a rule, increase production, decrease wheel wear, increase the life of the machine, and decrease the amount of power consumption. It is surprising how many operators erroneously believe that the faster the work revolves, the greater the amount of work produced. This fallacy is so prevalent and wide-spread that it seems almost hopeless to attempt to teach the real facts. To operate a grinding machine continually on the fastest work speed, is just as wrong and just as wasteful, as it would be for a lathe operator to run his machine continuously at a filing speed when turning work.

Through experience and intuition a lathe operator will usually approximate the correct speed at which to run the work and traverse the carriage to accommodate the cutting tool and the power of the machine. In fact, the chances are that he will set his speed and feed a trifle under those which the machine can conveniently stand. Yet the same lathe operator, if placed on a cylindrical grinding machine, will depart from the things he learned on the lathe, and use the fastest work speed with which the grinding machine is equipped.

Importance of Instructing Operators Concerning Proper Work Speeds to be Used

Perhaps the fault lies in the fact that the usual operator of a grinding machine does not really know his cutting tool—the grinding wheel. It is possible that he has no conception of what is taking place when the wheel and the work come in contact. For this ignorance he may be entirely innocent of blame; the fault may be due to improper or indifferent instruction. The probability is that the real encouragement for proper instruction must come from the executives of a firm who are directly interested in the cost of machines, wheels, and power consumed. Such executives would readily consider this subject if they were aware of the fact that scientific and mechanical laws enter into the subject of grinding just as they do in all other engineering questions, and that it is susceptible of proof by demonstration alone that with a fast, consistent table traverse, a soft wheel, and a relatively slow work revolution, which will permit the use of the full width of the wheel face per revolution of the work, the minimum power will be consumed with minimum wheel loss per volume of stock removed, and the maximum production obtained.

In these days with the price of coal constantly mounting and deliveries uncertain, power consumption is going to be looked into closer than hitherto, with an idea of conserving the coal supply. Grinding machines cannot long escape a close scrutiny, and so the fact that a battery of grinding machines operated in a hit-or-miss fashion consumes considerably more power than when operated in the correct manner, is going to be considered as bearing some relation to the amount of coal used.

Problem Presented to Illustrate Points under Discussion

A grinding machine is the best thing to have handy in attempting to demonstrate any statement about grinding, but when this is impossible the same points can be emphasized by a logical analysis. Assume that a man is grinding a bar of steel and using the fastest work speed and fastest table traverse with which the machine is equipped. This, as previously mentioned, is such common practice that it is reasonable to make the assumption. It will be further assumed that the exact conditions under which the operation is being performed are as given in the following:

Wheel: Diameter, 18 inches; width, 2 inches; diameter of hole, 5 inches; and constant speed, 6000 surface feet per minute.

Work: Length, 12 inches; diameter, 2 inches; and speed, 190 revolutions per minute (the fastest on the machine) or 100 surface feet per minute for a 2-inch diameter bar.

Table traverse: 150 inches per minute (the fastest on the machine).

Feed: Radial depth of cut, 0.001 inch per traverse of table, which is the maximum depth within the power of the machine for the speed and feed given.

Stock to be removed: Thickness, 0.025 inch. The ratio of cubic inches of stock removed to the cubic inches of wheel wear is 10 to 1.

An attempt will be made in the following to show the effect on production and wheel wear of a reduction in the speed of the work, production being considered as the volume of stock removed in a given time. If a thickness of 0.025 inch is to be removed from the surface of the work, and the depth of cut is 0.001 inch per traverse of the wheel, it is obvious that 25 traverses are necessary to grind one piece of work to size. The table traverses 150 inches per minute, and as the work is 12 inches long the machine makes 150 ÷ 12 or 12.5 traverses per minute. Hence the total of 25 traverses required to grind the work to size will be accomplished in 25 ÷ 12.5 or 2 minutes.

With a work speed of 190 revolutions per minute and a table traverse of 150 inches per minute, the amount of traverse for each revolution of the work equals 150 ÷ 190 or 15/19 inch. In other words, this means that a wheel with a face 15/19 inch wide would be just wide enough to present the full face width to the work at the speed and traverse mentioned. Continuing to use the same table traverse of 150 inches per minute, but utilizing the full width of the 2-inch face of the wheel, the number of revolutions per minute of the work would be 150 ÷ 2 or 75. In this way a new condition is set up whereby the full width of the wheel is utilized per revolution of the work rather than only 15/19 inch of the wheel face.

Wheel Becomes Glazed when Entire Face is not Used

When only part of the wheel face is used, the remaining part simply laps over on the surface ground during the preceding revolution of the work and there is a non-uniform wearing action. The portion of the wheel face which is not cutting, but simply dragging on the work, becomes glazed and adds useless friction to the operation, thus increasing the power consumption of the machine. As the particles of abrasives which stand the brunt of the cutting become worn away, the cutting action is passed along to the portion of the wheel face which has become glazed, and an undue stress is set up in making these glazed particles cut. This continuous transfer from cutting particles of abrasives to glazed particles consumes power to an extent that is apparent in the pulling power of the machine, as evidenced by the belts; this is no theoretical conclusion.

When the entire wheel face is grinding during each revolution of the work, a uniform wheel wearing action takes place, the burden of removing the stock is distributed over the entire face of the wheel, each individual particle performs its equal share of the work, the wheel face remains flat because of the uniform wear, and there is a consequent decrease in the amount of power consumed. The evidence of this comes to the operator in a practical way when he sees that by setting his work speed to this latter condition he is enabled to increase the radial depth of cut to a greater depth per traverse before again coming to the maximum pulling power of the machine.

Gain in Production Time by Increasing the Depth of Cut

Going back to the new condition of 75 revolutions per minute, we make another observation. As the table traverse per minute has not been changed, and the radial depth of cut per traverse remains the same, two minutes is still the grinding time per piece, and the production remains constant. It is known that the condition of using the full face of a wheel is ideal so far as power consumption is concerned, and thus a greater radial depth of cut will next be considered.

The importance of attempting to gain in the radial depth of cut is worth dwelling upon. It is interesting to note that even an increase of 0.00025 inch in the radial depth of cut permits the number of table traverses necessary to grind the work to size to be reduced to 20, as 0.025 ÷ 0.00125 = 20. The number of table traverses still remains 12.5 per minute, as the rate of traverse is unchanged, but the time consumed in grinding a piece is reduced, as 20 ÷ 12.5 = 1.6 minutes. This is a saving of almost half a minute in grinding each piece, which is worth considering in a day's output.

Results Obtained by Reducing the Work Speed

Using the same conditions, a study will now be made of the effect on the amount of stock removed in its relation to wheel wear of changing from a work speed of 190 revolutions to 75 revolutions per minute. Professor George I. Alden has evolved a graphic analysis of the action of a grinding wheel, by which, through clearly graded mathematical steps, certain principles of grinding are revealed. These principles give to the empirical rules for changes of speeds and feed, a rational basis from which to draw conclusions that run true to practice. In this analysis a depth of cut other than the radial depth of cut is introduced, this being known as the "grain depth of cut." It is unnecessary to go into the details of the theory other than to note a few foundational figures, which follow:

100 = the number of surface feet per minute of the 2-inch diameter bar at 190 revolutions per minute;

40 = the number of surface feet per minute of the 2-inch diameter bar at 75 revolutions per minute;

6000 = the number of surface feet per minute of the 18-inch diameter grinding wheel;

0.0475 = the value of the sine of a certain angle dependent upon the three factors, the diameter of the work (2 inches); the diameter of the wheel (18 inches); and the radial depth of cut (0.001 inch). The grain depth of cut, when the surface speed of the work is 100 feet per minute, is found as follows:

$$\frac{100 \times 0.0475}{6000 \times 1} = 0.00079 \text{ inch}$$

and when the surface speed is 40 feet per minute,

$$\frac{40 \times 0.0475}{6000 \times 1} = 0.00032 \text{ inch.}$$

This shows a reduction in the grain depth of cut when the work speed has been changed from 190 revolutions per minute to 75, equal to $\frac{0.00079 - 0.00032}{0.00079}$ or about 60 per cent. A gain of a less amount of wheel wear is always directly proportional to a reduction in the grain depth in a free-cutting wheel if the traverse of the table has not been changed. In the case considered, the table traverse remained constant at 150 inches per minute for both work speeds. At the beginning of the problem it is stated that for this particular wheel under the conditions given, the ratio of stock removed to wheel wear, measured in cubic inches, is 10 to 1, and as the reduction of 60 per cent in the grain depth of cut is directly related to wheel wear, it is evident that a new ratio of stock removed to unit of wheel wear can be figured.

The original wheel wear was given as 1, and as the wheel wear when the surface speed of the work is 40 feet per minute, is 60 per cent less, the new wheel wear is 0.4 as compared to the original. The original stock removed was represented as 10 in its relation to the original wheel wear. With the present relation of 0.4, a new ratio of 10 to 0.4, or 25 to 1 is obtained.

Thus, it will be seen that a change of work speed from the original 190 revolutions per minute to a new rational speed of 75 revolutions per minute increases the amount of stock removed per unit of wheel wear 150 per cent; but someone may say that it is inconceivable that a wheel which removes such a good ratio of stock to wheel wear as 10 to 1 with a work revolution of 190 revolutions per minute, will also act as a free-cutting wheel at the slower rate of revolution, and that surely the slower rate of revolution will make the wheel act the same as a harder wheel.

These things are true, which brings up the following point: The figures given pertaining to stock removed and wheel wear do not take into account certain physical laws which enter into grinding-wheel action. The figures are correct, however, and are good for illustrative purposes. The real condition met with in actual grinding would be that a

softer wheel and a slower rate of work revolution would need to be used in order to make the wheel cut at all. The ratio of stock removed to wheel wear would therefore be reduced to about 12 to 1, or 15 to 1, with the softer wheel. However, and here is the advantage of the whole thing, the use of the soft wheel would permit an additional increase in the radial depth of cut because of a less amount of power consumed in the grinding action of a soft wheel, and the actual gain in the time taken to remove the stock would more than compensate for the loss in the ratio between the stock removed and the wheel wear.

Under these new ideal conditions there is an opportunity to operate the machine with a radial depth of cut of 0.0015 inch. This, of course, changes the number of traverses of the table necessary to grind one piece of work, which is found to equal 0.025 ÷ 0.0015 or 17 traverses. By dividing this number by 12.5—the number of traverses per minute—it will be seen that 1.3 minutes is required to grind the work. Before proceeding to another consideration of the effects of operating a machine at the fastest work speed, it might be well to say that the figures relating to grinding time do not take into consideration certain time losses that invariably enter in, to make the cut appear to be held somewhat in suspension. The grinding time under actual conditions would be greater in each case.

Effect on Wear of Wheel and Output when Wheel is Fed by Hand

The cases presented show what is happening to a wheel and to production when a fast work speed is being used in conjunction with a constant, predetermined automatic radial feed. What happens when the operator feeds the wheel in by hand, irregularly, is beyond calculation. It is safe to begin this phase of the consideration of the subject by saying that an operator can make any wheel act too soft, and can even make a very hard wheel act softer than a much softer wheel by abnormal hand-feeding. This is especially noticeable in the rough-grinding of camshafts from rough forgings.

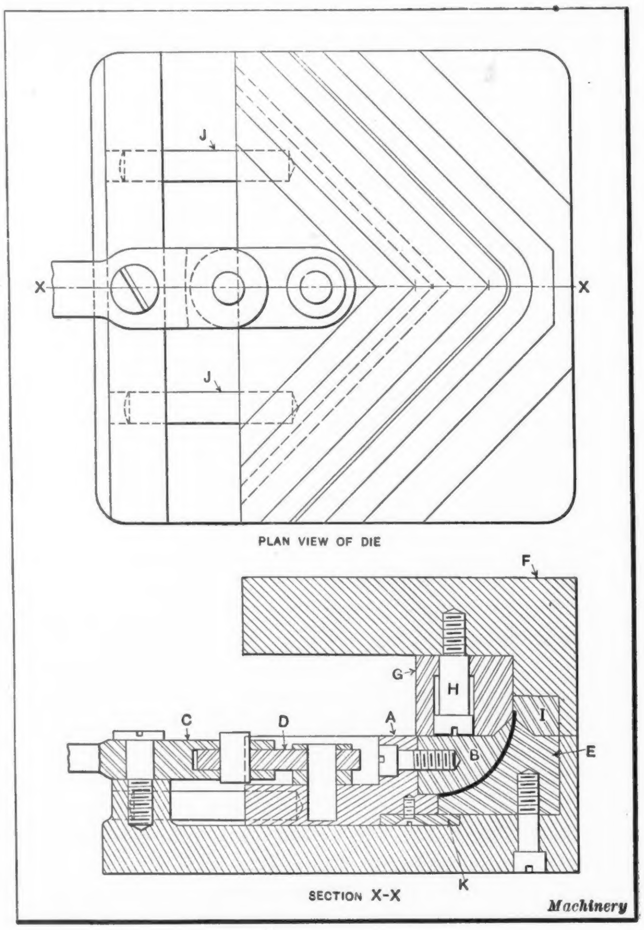
The writer has seen a considerable amount of good rough-grinding on camshafts with a 36-O Norton wheel, the work speed being comparatively slow, the wheel feed deep but steady, and the wheel-slide not gibbed to the wheel-slide base. The amount of production under these conditions, with the least effort on the part of the operator, was exceedingly good, and the full capacity of the machine was utilized. The writer knows of a similar operation, where the operator started with a slow work speed and a relatively soft wheel, and as time progressed, increased the work speed by steady stages to the maximum and the grade of hardness of the wheel until a 30-S Norton wheel was found to be too soft for the work. In this case, the wear of the wheel was 0.080 inch per camshaft.

In the course of the evolution from a soft to a hard wheel the operator found that it became necessary to first put scrap castings on the wheel-slide to hold it down, then to gib the wheel-slide to the wheel-slide base, and to replace the spindle boxes of the machine with new ones. The vibrations caused by forcing the work against the over-hard wheel made the table jump as much as 0.015 inch from the base. No machine can long stand such abuse as this. To follow up such an unnecessary and unreasonable style of grinding to a likewise unreasonable conclusion would mean that the machine would have to be made more solid, the wheels would have to be made harder and the belts wider, and the driving power increased; this cycle would never end. A wheel wear of 0.080 inch per shaft is excessive and exceptional, but the fact remains that similar grinding practices to a minor degree are common in many of our industries. An overfast work speed is the basic cause of most cylindrical grinding troubles, and eventually, when this is more generally known, the method used by the operator will be governed more closely by someone in authority who has made a study of the principles underlying grinding.

DIE FOR CURLING RIGHT-ANGLE STOVE TRIMMINGS

By J. BINGHAM

A punch and die of somewhat unusual construction is employed in curling right-angle trimmings such as found at the corners on the tops of most types of cooking stoves. In many instances these trimmings are nickel-plated after having been bent to shape. The die here illustrated has a movable member *A* that is operated in a horizontal direction to permit the removal of the work. Slide *A* has a steel face *B* and is operated by hand through the medium of lever *C* and link *D*. The flat strip metal from which each trimming is formed is cut to the proper length and then bent around a bar of circular cross-section to the shape of an approximate



Die used in curling Stove Trimmings

right angle. After slide *A* has been moved into an almost closed position, the lower edge of this bent strip is placed between face *B* and die part *E* at the top of these two members. Then as slide *A* is moved to its closed position, this edge of the strip is bent to a true right angle.

On the downward stroke of punch *F*, pad *G* descends an amount ahead of the punch equal to the movement permitted by the counterbored holes in which the heads of several special screws *H* are contained. A number of coil springs exert sufficient pressure on pad *G* to cause the strip metal to be pushed to the front of the pad as it descends, and so the pad forms a backing for the metal during the remainder of the operation. Then, as the punch continues to descend, the steel face *I* forces the strip metal into the space between face *B* and die part *E*, causing the strip to be curled and at the same time bending it to the shape of a true right angle. The space between face *B* and part *E* is about 0.025 inch wider at the bottom than it is at the top, to allow for the upsetting of the metal. Plate *K* extends beneath part *E* when the slide is in the closed position; this prevents the lifting of the slide when the metal in the work is being upset. The two guide pins *J* keep slide *A* in correct alignment.

Compound Blanking, Forming and Piercing Die

By F. H. LE JEUNE, Divisional Chief Engineer, Wire and Steel Division, Hayes Wheel Co., Jackson, Mich.

THE tractor wheel spoke cover stamping shown in Fig. 1 was originally made in four operations, and in order to reduce the amount of time required to produce the stamping, a compound die was designed, the construction of which is described in this article. The stamping is made of No. 16 B. & S. gage stock, 0.065 inch thick, and contains twelve 11/32-inch holes and a central hole 3⅛ inches in diameter through a formed flange. The series of operations previously employed to produce this part was as follows: (1) Blank and first draw; (2) redraw; (3) Cut out bottom of cup, trimming neck to length; and (4) pierce holes. The third operation was performed on a lathe.

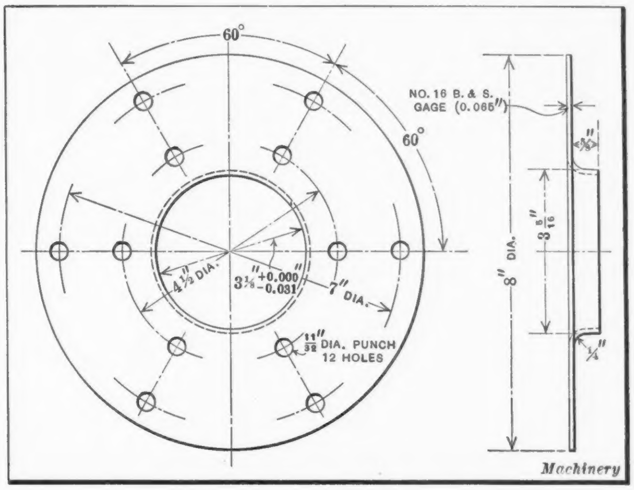


Fig. 1. Tractor Wheel Spoke Cover produced in One Operation by the Die shown in Fig. 2

In considering a means of reducing the cost of producing the work, it was evident, as long as the drawing operation entered into the manufacturing problem, that the piercing of the holes would need to be a separate operation. The drawing operation, therefore, was the first detail to require a change. It was decided to punch the center hole to the proper diameter so that the neck could be formed by spreading the metal around the hole. The method of ascertaining the diameter of punch to use was arrived at experimentally, a punch and die being made with a set of removable pilots of slightly varying diameters. A strip of production stock was then drilled so that the holes would be of suitable size for performing the experiment by means of which the size of the pilot was to be determined. The experimental equipment was then set up on an arbor press, and thus the proper size hole was found which would stretch into the required length of neck without breaking the metal.

From these experiments it was also learned that all the operations could be performed at a single stroke of the press if the proper sequence of operations was established. This order was subsequently incorporated in the die illustrated in Fig. 2, and the functioning parts were timed to first punch the center hole; second, stretch the neck; third, punch the twelve small holes after the center forming punch had advanced sufficiently so that further movement would not cause the stock to draw toward the center; and fourth, blank to the required size. The timing of the center forming punch is a vital factor in the successful operation of the die, for any movement of the stock after the small punches are in action, would probably result in these slender tools being broken.

Referring now to the sectional view of the die, it will be seen that it is of the sub-press type, there being two pillars employed to align the upper and lower members. The upper member of the die consists of the usual holder *A* with a steel punch plate *B* in which the center forming punch *C* and the twelve piercing punches *D* are carried. The upper pressure pad *E* is backed by a series of six heavy coil springs *F*, so that as the die is being closed, the stock which is shown by heavy lines in the illustration, will be firmly held against the upper surface of the lower die *G*.

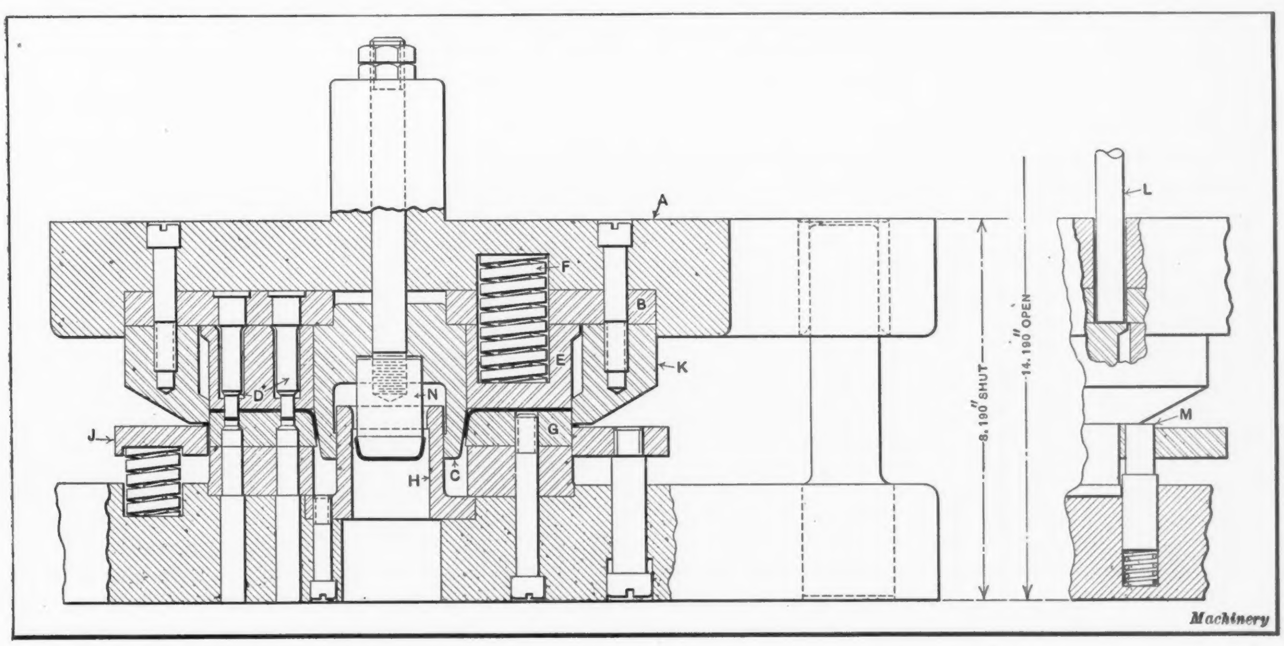


Fig. 2. Compound Die of the Sub-press Type used in making Tractor Stampings

The lower holder carries the center punch *H* and supports the plate *J* by six coil springs, so that as the blanking punch *K* carries the scrap stock downward after the stock has been blanked, the springs will be compressed in readiness to eject the scrap as soon as the dies have opened again. These members, two knock-out pins *L*, and one gage pin *M* (shown in the partial view at the right of the die) were incorporated in the original design and were found to produce the stamping as planned.

Trouble was experienced in the operation of the die however, in that the center slugs were pushed up into punch *C*, for although the knock-out in the ram would push the slug out again, it became necessary for the operator not only to feed the stock into the die and remove the finished work, but also to remove this scrap center. Herein lay the difficulty for, as all men who are familiar with punch press work know, it is difficult to remove a thin flat steel disk, covered with oil, from the ground face of a die. To eliminate this objectionable feature a small drawing punch *N* was provided in the center of the upper die member and a drawing die incorporated in punch *H* by making it in the form of a flanged ring, as clearly shown in the illustration. By this provision the center slug was drawn to a cup shape, thus reducing its diameter so that it could be readily pushed through the center of the die. It will be seen that the end of punch *N* is tapered so that the scrap will be readily stripped from it as the drawing punch ascends through punch *H*.

The operation of the die is as follows: After the stock has been fed into the die the press ram descends forcing the blank below punch *H*, immediately after which the center forming punch *C* starts to operate and form the neck. After the center forming punch has proceeded downward far enough to prevent the stock from creeping toward the center, punches *D* are brought into operation and pierce the twelve small holes in the work. Directly after the holes have been pierced punch *K* blanks out the work. During these operations, the center slug has been steadily forced down through the center punch *H*, forming the cup as previously mentioned. This completes the cycle of operations, so that as the die is opened, it is only necessary for the operator to remove the finished work from the face of the die and proceed as before. The punchings from the small holes pass down through clearance holes in the lower die member. In addition to the time saved, this die was the means of saving one-half inch of metal from the width of the stock.

* * *

WORK OF THE BUREAU OF MINES

The Bureau of Mines has been provided with magnificent central laboratories at Pittsburg during the past year. For the first time in its existence, the Bureau of Mines has a suitable home and central headquarters for field and investigation work, and will be able to be of greater usefulness to the mining and metallurgical industries in the future. The facilities of the bureau are at the disposal of private organizations upon certain conditions. Any private company that has a mining or metallurgical problem, the solution of which would benefit the company and the public, may appeal to the bureau for assistance. The firm agrees to pay part or all of the costs in personnel and materials for the investigation, which is carried on under the direction of the bureau; but the bureau retains the right to make public and print the results of the investigation. The facilities of the bureau are such that in many instances it can do investigation work that would be impossible for a private firm to undertake. At present, the bureau has cooperative agreements with nineteen firms for work of this kind. The total amount of money that has been spent by outside interests under these cooperative agreements under the direction of the bureau has amounted to approximately a half million dollars during the past year, and every indication shows that this service will grow in importance.

JIG FOR ASSEMBLING GEARS AND COLLAR ON SHAFTS

By F. SERVER

The assembling of two gears and a collar on a shaft by means of pins, when the gears and collar must be accurately located relative to each other and to the shaft ends, is accomplished by the use of a jig described in the following. The manner in which the gears and collar are mounted on the shaft will be apparent by referring to Fig. 1. The jig used in the assembling operation is illustrated in Fig. 2. Provision has been made in this jig for locating the shaft and clamping it in position, and for locating the gears and collar on the shaft correctly and clamping these parts in place. The drill bushings are contained in hinged covers, which can be lifted after the pin-holes have been drilled, so that the holes can be reamed while the parts still remain in the jig.

By reference to Fig. 2 it will be seen that the various members of the jig are attached to the long cast-iron base *A*. A tool-steel plate *B*, slotted to conform with the tapered end

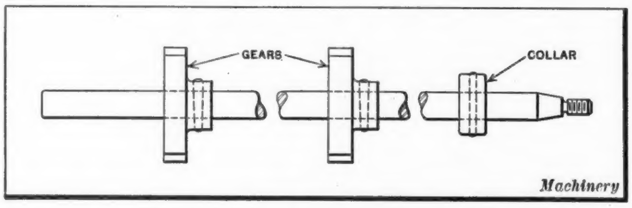


Fig. 1. Shaft with Gears and Collar assembled on it by the Use of the Jig shown in Fig. 2

of the work and being provided with clearance for the threaded portion at the same end of the shaft, is mounted at the right end of this base. The flat spring *C*, at the opposite end of the jig, pushes the shaft into the slotted plate *B*, thus locating it endwise and sidewise; block *D* locates the shaft at the left-hand end. The shaft is supported by the locating blocks *D*, *E*, and *F* and by the finished top surface of lug *G*, being clamped on the latter by means of screw *H* when the screw is turned so that the circular portion of its head comes over the shaft. The gears and collar are put on the shaft before it is placed in the jig, being spaced so that the hubs of the gears will be placed against locating blocks *D* and *E*, respectively, and one side of the collar will be placed against the locating block *F*. The gears and collar are clamped in place by means of clamps *I*, which are provided with a recess at their upper ends to clear the shaft. These clamps are operated when shafts *J* are turned by means of rods *K*, the eccentrics *L* on shafts *J* causing the clamps to swivel on pins *M* so that their upper ends tighten against the gears and collar. This arrangement insures the accurate location of the parts to be assembled. To loosen the clamps, shafts *J* are turned in the opposite direction, springs *N* forcing the clamps away from the gears and collar.

The bushings *O*, used in drilling the holes, are contained in the three hinged covers *P*. The covers pivot on pins *Q*, provision being made for fastening them down after the work has been inserted in the jig. This is accomplished by means of three locking levers *R*, shown clearly in the end view. These levers swivel on pins *S*, springs *T* holding them in the locked position when the cover is down. A curved surface on the top of each lever causes the lever to spring out readily as the cover is lowered. It is necessary for the operator to hold the levers back in order to raise the covers.

In operation, a straight hole is drilled through the collar and shaft, the drill being guided by the bushing in the hinged cover above the collar. The cover is then lifted and a straight hole is reamed through the collar and shaft. The two holes to be drilled through the gears and shafts at these points are for taper pins. The manner in which these holes are produced is to drill a straight hole part way through each gear and the shaft, then substitute another straight drill of a smaller size in the machine spindle and drill a hole through

the remainder of the shaft and the lower side of the hub in each case. A depth gage *U* is provided to serve as a contact for a stop-collar on the drilling machine so that the hole produced by the drill used in the first step, will not be drilled too deep. After the smaller size hole has been drilled, the hinged covers are swung back and the holes are taper-reamed.

This method of drilling a taper pin hole enables quicker reaming of the hole, as the stepped diameters left by the two sizes of drills allow the reamer to start cutting at a point midway through the hole. However, care must be taken to see that the two drills are of correct relative diameters so that the finished hole will conform to the reamer throughout its entire length. Another point to be noted in the construction of the jig is that pins *V* are provided so that pins *W* will strike against them when shafts *J* are turned too far, and thus prevent rods *K* from hitting surfaces on a level with, or beneath the bottom of, the jig base when handling with the work removed. Should this occur the rods would probably be broken. It is obvious that by the use of this jig, the gears and collar can be mounted so accurately that all shafts will be interchangeable.

* * *

The development of the American railway system is well indicated by the increase in the size of rails used on leading American railroads. In 1875, the Pennsylvania Railroad introduced 60-pound rails, which were considered heavy at that time. In 1884 the first 70-pound rails were laid, followed in 1886 by 75-pound rails, and in 1887 by 85-pound rails. It was only five years later that the first rails weighing 100 pounds to the yard were laid by the Pennsylvania Railroad. These 100-pound rails have now been found to be insufficient for the heavy cars and locomotives and the steadily increasing traffic of the present day, and the work of replacing the 100-pound rails in the main line tracks with rails weighing 125 and 130 pounds to the yard is now proceeding at a rapid rate; 125-pound rails are used on level straight track and 130-pound rails on heavy grades and curves, were the strain imposed upon the track by the increase in weights in locomotives and cars is the greatest. A careful study of rails was made during a whole year, previous to making a decision to put in heavier rails. It was found that a heavier rail would insure a greater degree of safety and would in the long run prove economical because of its greater endurance.

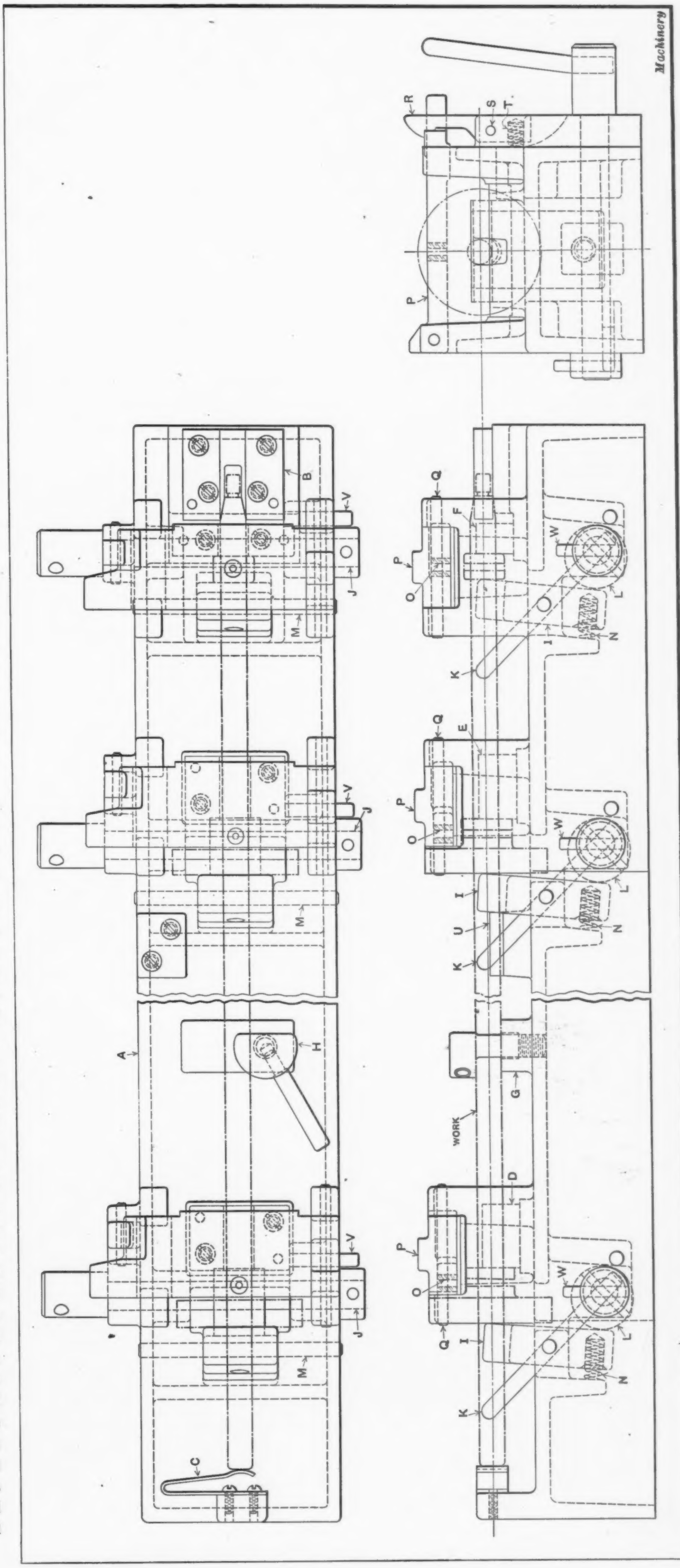


Fig. 2. Jig for locating Gears and Collar on Shaft shown in Fig. 1, and holding them in Position while being drilled

Machining Cream Separator Bowls

Methods Employed by the De Laval Separator Co., Poughkeepsie, N.Y.—Second of Two Articles

IN the previous article on this subject, published in the December number, the manufacture of the tubular shaft which, with the bowl shell, forms the housing within which the separation of cream occurs, was described. The present installment deals with the procedure followed in producing the bowl shell of the cream separator.

The bowl shell is made from hot-rolled steel, 0.180 inch thick, having the following analysis: Carbon, 0.08 to 0.12 per cent; manganese, 0.35 to 0.50 per cent; phosphorus, 0.01 to 0.018 per cent; and sulphur not over 0.045 per cent. The shell is made by a series of power-press operations, the first two of which consist of a blanking and a straight drawing operation. After the first drawing operation, the work is annealed to relieve all strains produced in the preceding operation and the surfaces are tallowed to prevent the dies used in the subsequent operations from becoming abraded by the rough surface of the shells. The next operation is a redrawing operation, which is followed by seven forming operations for the purpose of producing the neck *L* and conical surface *M* of the shell. (See Fig. 1 in the December article.)

The press work of forming the neck on these heavy shells is performed on Toledo open-back geared presses, two of which are shown engaged in the performance of the first two necking operations in Fig. 13. The appearance of the shell before necking may be seen by reference to the chute in the foreground of the illustration. A stripper is employed on these presses to remove the shell from the punch. The production rate on each necking operation is 300 pieces per hour. The shells are then sent back to the annealing room, where they receive the same treatment as before, after which they are returned to the press shop where three more neck-forming operations are performed, the first of which is illustrated in Fig. 14. This operation consists of finish-forming the shell with the punch shown at *A*, and of piercing the hole in the bottom of the neck with the piercing punch *B*. This auxiliary equipment enables two operations to be performed with one stroke of the press ram. The machine used is a No. 59¼ Toledo straight-sided double-geared press, and the production rate, as in the other necking operations, is 300 pieces per hour.

The shells are next returned to the annealing department to be annealed and tallowed before the final forming of the shell is accomplished. Fig. 12 is a view of the annealing room, and shows the equipment employed to hoist the annealing pots from the furnaces and deposit them outside to cool. This is accomplished by means of a heavy overhead structure, with a hoist for raising the extending arms on which the annealing pots are lifted. Attention is directed to the ball track, shown in the foreground of the illustration, by means of which the annealing pots are rolled into the furnaces. The work is sealed in the annealing pots with fire-clay, heated for five hours at a temperature of 1450 degrees F., and then removed and allowed to cool in the pots. The tallowing operation consists simply in dipping the shells

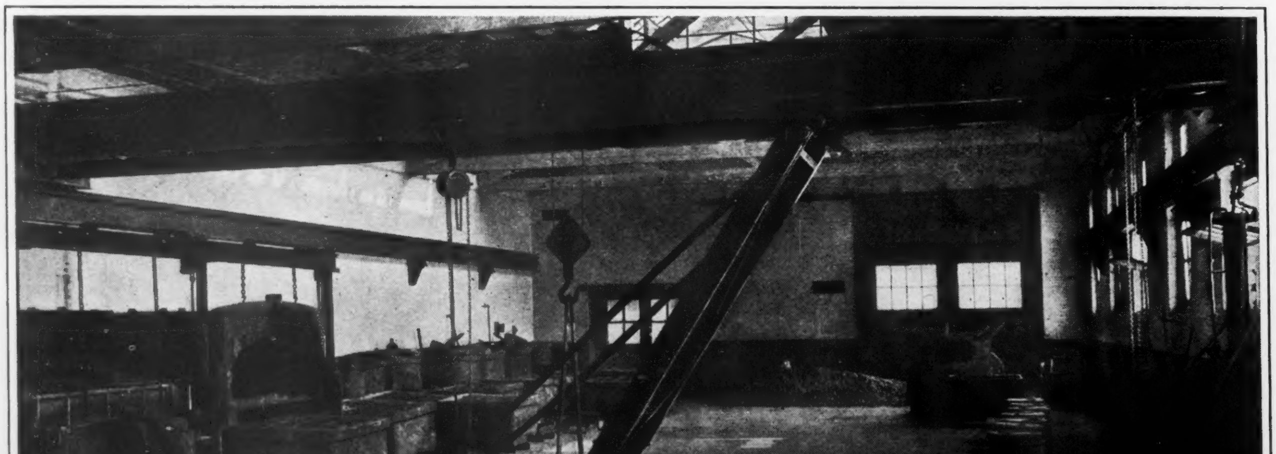


Fig. 12. View of the Annealing Room, showing a Battery of Furnaces and Several Annealing Pots Ready to be deposited in the Furnaces

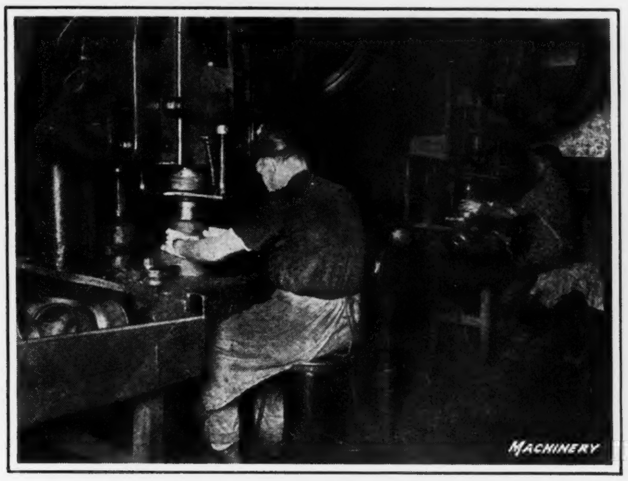


Fig. 13. Open-back Geared Presses employed in necking the Shell

Fig. 14. Finish-forming the Shell and piercing a Hole in the End

in hot tallow and placing them on a conveyor which carries them over a gas flame for the purpose of permitting the tallow to saturate under the scale on the shell.

This is accomplished by means of the punch and die illustrated in Fig. 16, at *A* and *B* respectively, in conjunction with the expanding arbor *C* which fits into the shell after it

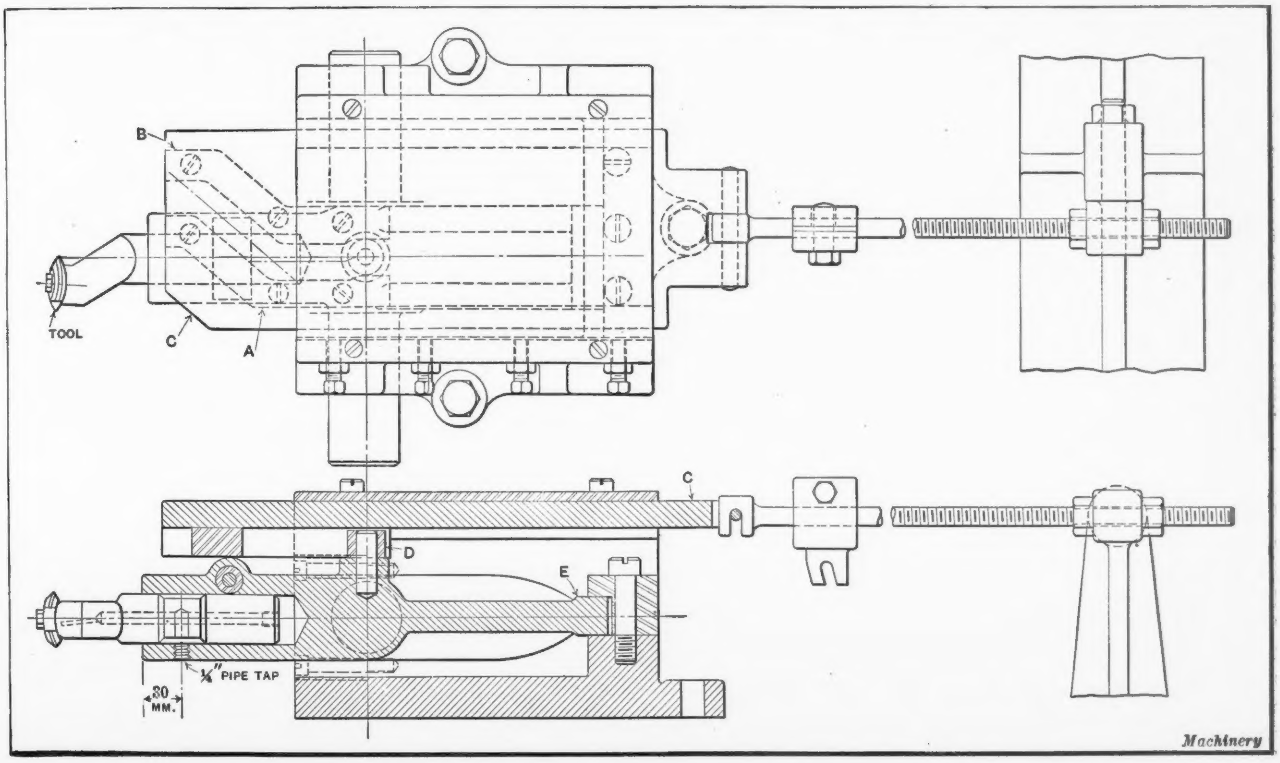


Fig. 15. Sectional and Plan Views of the Attachment used in machining the Interior of the Shell. This Attachment is applied to the Lathe shown in Fig. 17

After being tallowed, the shells are drawn to finished size, and then the contour at the bottom of the shell is formed.

is located in the die, so that as the forming ring of the punch encases the shell, the continued pressure exerted by the

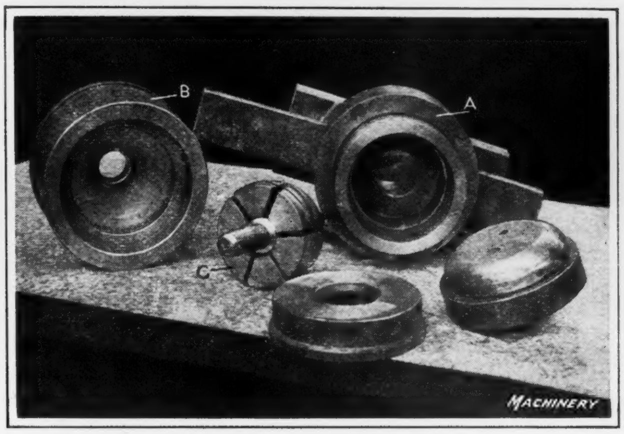


Fig. 16. Some of the Tools used in the Press Work. Expansion Arbor C fits in the Shell, producing the Correct Curvature when formed by Punch A

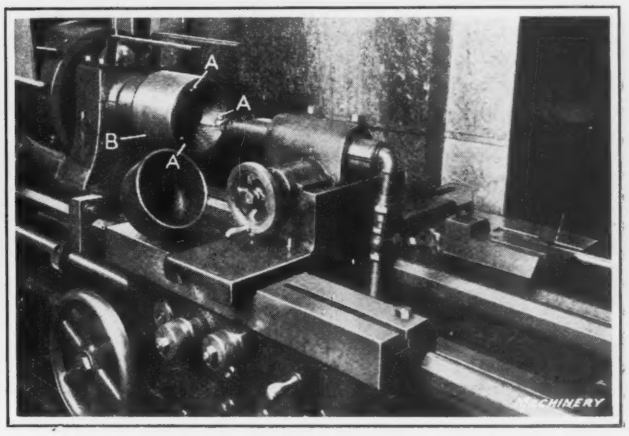


Fig. 17. Lathe equipped for roughing out the Interior of the Shells. The Lathe is equipped with an Air-chuck and Taper-turning Attachment

downward stroke of the press ram will produce the desired curvature. The construction of the expanding arbor is shown in Fig. 18, from which it will be seen that a taper on mandrel *A* enables the segments to be expanded to fit the contour of the interior surface of the shell. A coil spring is wound around a groove in these segments, which provides the yielding construction necessary. The production rate on this curling operation is 500 pieces per hour with two operators working on one machine. The other

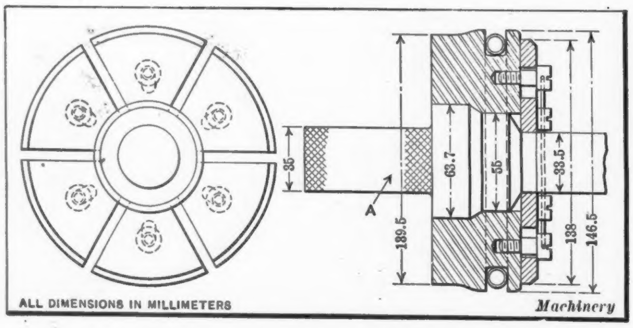


Fig. 18. Sectional and End Views of the Expansion Arbor used in curling the Bottom of the Shell

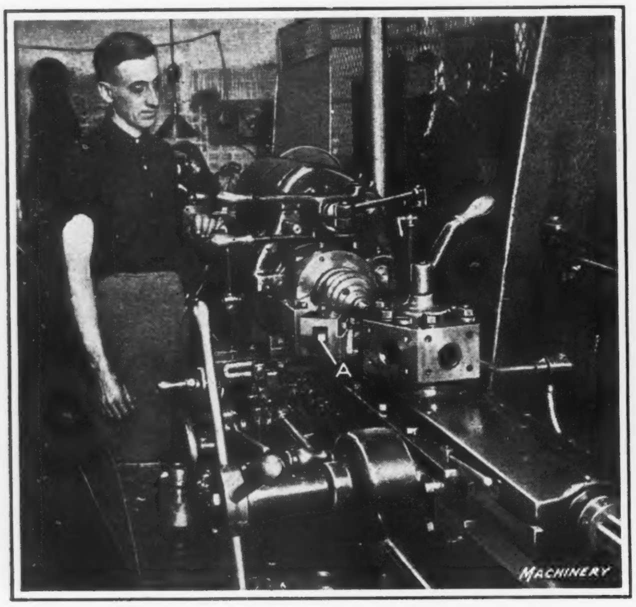


Fig. 19. Finish-turning the Neck of the Bowl Shell on a Hexagon Turret Lathe

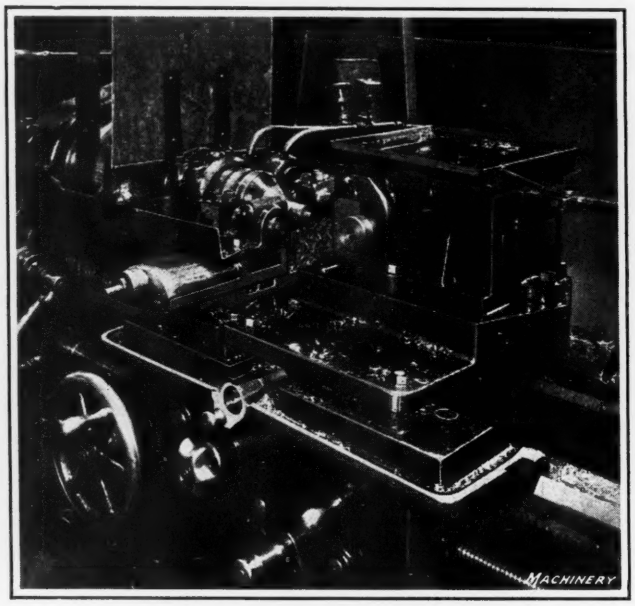


Fig. 20. Set-up of Lathe for turning Outside of Shell, using Special Turning Attachment

punch and die shown in Fig. 16 is the equipment used on the blanking and drawing operation of the shell.

The flow of metal during the forming operations produces an irregular edge at the bottom of the shell, which in the first machining operation is trimmed to length. Operation 2, performed on a Brown & Sharpe No. 6 hand screw machine, consists of rough-boring the interior shoulder, the rate of production being 109 shells per hour. Operation 3 consists of rough-turning the neck, and boring and rough-reaming the hole at the end of the neck. This work is also performed on a Brown & Sharpe hand screw machine, using a box-tool for turning the neck and a floating reamer for rough-reaming the hole. The rate of production is forty-eight shells per hour.

Operation 4—the roughing out of the interior of the shell below the neck—is illustrated in Fig. 17, and the attachment used is shown in detail in Fig. 15. It will be seen that cams *A* and *B* attached to slide *C* form the path within which the hardened steel cam-roll *D* operates. The cam-roll path is such as to enable the tool, which is carried in the tool-holder *E*, to turn the interior of the shell to the correct contour as it feeds into the shell. These two illustrations should enable the operation of this taper-turning attachment to be clearly understood. The work is held in an air chuck and is drawn against three locating points *A*, Fig. 17, within the chuck, and located concentrically by means of a pilot within the machine spindle, which engages the hole in the end of the neck. A split collet which engages the outside of the neck within chuck *B* operates in a floating ring within the spindle, and holds the shell concentric by the rough-turned neck, regardless of any eccentricity which may exist between the surface of the neck and the outside of the shell. This work is performed on a Prentiss lathe at the rate of 90½ pieces per hour.

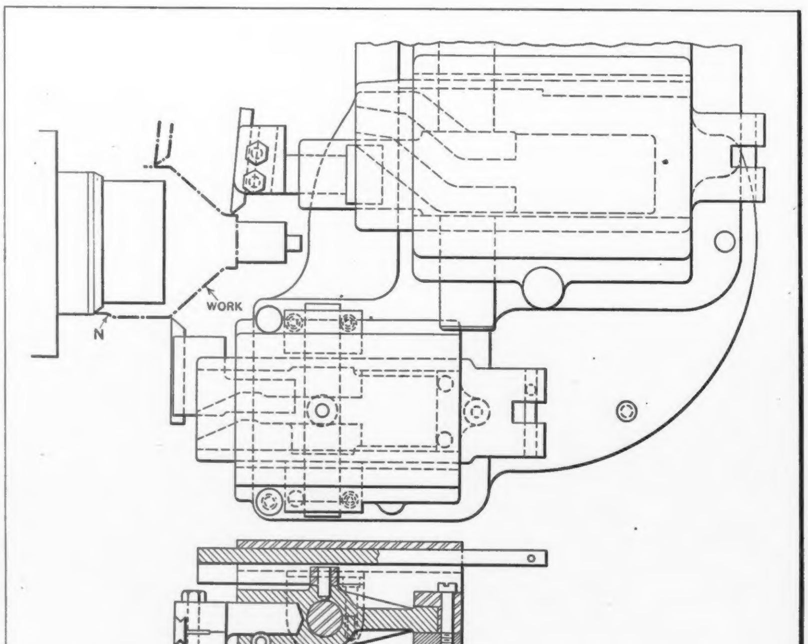


Fig. 21. Plan and Partial Sectional Views of the Double Turning Attachment employed in machining the Outside of the Shell

The next machining operation, which is the finish-turning of the neck, is performed on the Warner & Swasey hexagon turret lathe shown in Fig. 19. A tool in the toolholder on the cross-slide chamfers the end of the neck, while a tool carried in a toolpost at the back of the lathe performs a similar operation on the inside of the hole. The turning tool *A* is carried in the turret of the lathe. The work is finished to within limits of 0.05 millimeter, and is held on an arbor which fits the inside of the shell and which is provided with a draw-bar and air chuck to hold the shell against the angular surface of the tapered arbor. By locating the shell from the interior surface, concentricity between it and the finished surface of the neck is assured. The production rate on this job is 27 pieces per hour.

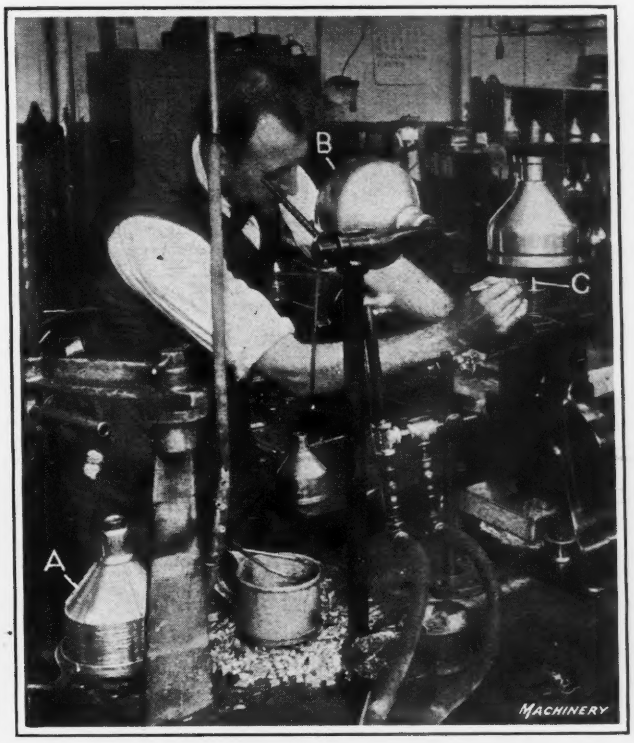


Fig. 22. Equipment used in placing the Assembled Shells in Dynamic Balance

The sixth operation, in which the outside of the shell is turned, is performed in a Chard 16-inch lathe, as shown in Fig. 20. This machine employs a special cam-slide turning fixture, a modification of the design of which is shown in detail in Fig. 21. This illustration shows the two tools, which are used simultaneously, and their relative position to the work; the work is shown in heavy broken lines. The contour of the cam, which guides the tool in turning the conical part of the shell, is such that at the end of this operation the tool turns the radius which joins the conical surface with that of the cylindrical body and then passes off at a tangent, so that the two surfaces being turned in this operation merge at this point into a nicely formed arc. The position of the tool as it leaves the work is also indicated by heavy broken lines.

The contour of the cam used for turning the cylindrical part of the shell also provides for turning the surface *N* to the proper curvature. This fixture is attached to the lathe carriage in such a manner that the regular longitudinal and cross feeds can be employed. Inspection of the sectional view will make it apparent that this attachment is similar in construction and operation to that shown in connection with the fixture used in Operation 4 illustrated in Fig. 15. The rate of production is 26 pieces per hour.

Operation 7 is that of reaming the inside of the neck and finishing the shoulder within the shell where the neck joins the lower part of the shell, so that this surface will blend with that of the inside wall. This work is performed on a Warner & Swasey turret lathe at the rate of 27 pieces per hour. A single-point tool is employed to machine a recess within the neck of the shell, and a forming tool provided with a roller pilot is used for finishing the shoulder. As in most of the operations on the bowl shell, an air-operated chuck is used to hold the work. The function of this recess is to permit any accumulated cream to be discharged through a small drain hole, which is later drilled into the recess. This is a sanitary provision to prevent any accumulated cream from souring by permitting it to drain out of the machine.

The necks of the shells are next polished in a speed lathe, by the use of oil and aloxite cloth, after which a pin-hole is drilled and tapped, in which the pin that engages the pin slot in the tubular shaft is screwed. In line with this hole and located in the neck of the shell, another hole is drilled which is the starting point for the milling cutter used to mill the slots in which the cream outlet lug on the top cone fits. The milling of this slot, which is the tenth operation in machining the shell, is performed on a Whitney hand miller provided with a Porter-Cable milling head. The production rate is 95 pieces per hour. Operations 12 and 13, which consist of milling the milk-slot, are also performed on Whitney hand milling machines. The preliminary milling operation is illustrated in Fig. 23, which shows the hand-operated chuck that holds the work by the neck and an end-mill that produces the two cuts *A* on the inside of the neck. The depth of these cuts is such that the diameter across them is equal to the diameter of the outside of the neck, so that they nearly break through. In the second milk-slot milling operation the slots are opened, using the same type of equipment and a T-cutter, to machine the sides of the slot parallel. The first milling operation produces 83 parts per hour, and the second, 150 per hour.

After the burrs produced in machining the lug slot and milks outlets have been filed off, the work passes to the machine shown in Fig. 24, in which the fifteenth operation is performed. This operation consists of facing the top of the

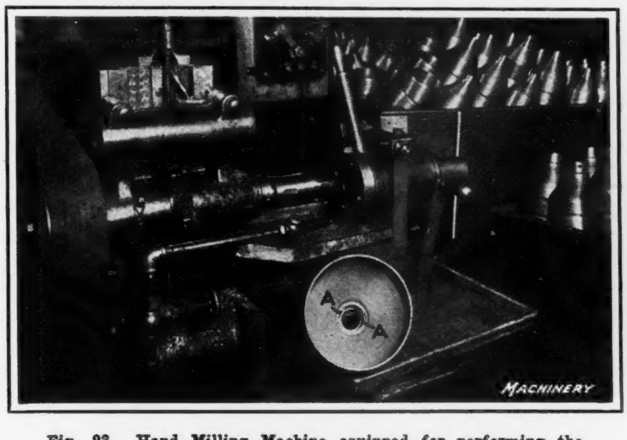


Fig. 23. Hand Milling Machine equipped for performing the Preliminary Milling Operation in the Machining of the Milk-slots

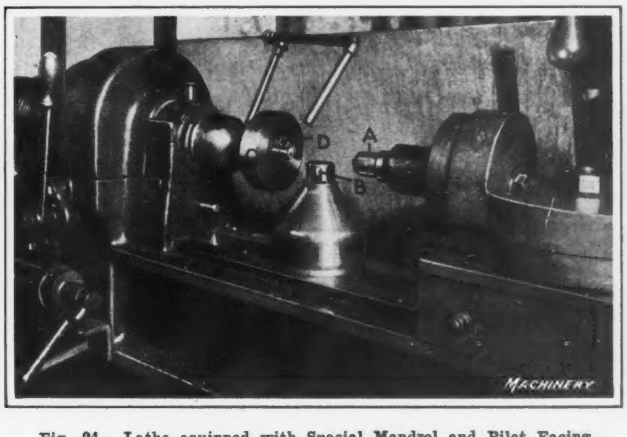


Fig. 24. Lathe equipped with Special Mandrel and Pilot Facing Head for finishing the End of the Neck Concentric with the Interior of the Shell

shell, the work being held by means of a lug on mandrel *A* which acts as a key to engage the lug slot *B* of the work. A hole in the end of the mandrel receives pilot *C* of the cutter-head, in which the pilot is a sliding fit. The axial pressure exerted between the mandrel and the cutter *D* holds the work securely on the tapered surface of the mandrel so that there will be no vibration between the work and the cutter, and no inaccuracies will result. In this operation the shell is held stationary while the cutter revolves.

The remaining operations required to finish the shell are of a less interesting nature than those already described, and for that reason will merely be mentioned. They consist of drilling the discharge hole for the recess within the neck; broaching the milk outlet; removing burrs; polishing; and retapping the pin-hole and removing the burrs from the inside of the shell produced by this operation. The bowl is then sent to the tinning department where it is immersed in a stannic bath.

As is the case with the tubular shaft, the bowl receives a careful inspection before the bowl proper is assembled. After assembly, the unit (including the stack of tin cones, distributor, etc.) is carefully balanced, the operation being illustrated in Fig. 22. This illustration shows a bowl mounted on a motor-driven vertical spindle on which it is balanced as a unit. The tin cones mentioned in the preliminary description of this machine are numbered so that, if kept in their numerical order after the proper dynamic balance has been established, this condition will not become disturbed after the machine is in commercial use, either during washing the cones, or when disassembling the bowl for any other purpose. In the illustration, the stack of cones *A* is in view, and the bowl shell *B* has been removed from the bowl unit, being supported on a bracket, in which position solder is put into the shell by the balancer, when placing the unit in perfect running balance. A number of solder slugs will be seen on the table, and attention is also directed to the use of a gas flame which is applied to the outside of the shell, as it is supported by the bracket, so as to melt the solder on the inside.

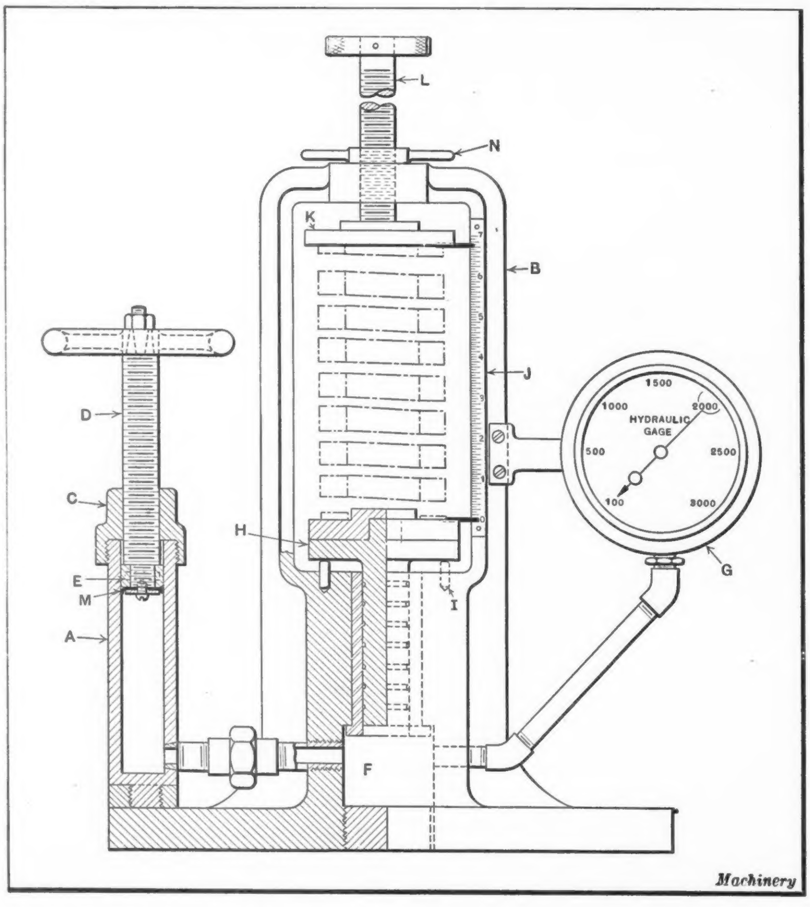
A great deal of experience is required by the workman to select pieces of solder of exactly the right weight to overcome the estimated amount that the shell is out of dynamic balance. The driving spindle *C* is supported at its lower extremity by a step, and at the upper end in a yielding spring bearing, so that if the shell is out of balance the spindle, when run at a high velocity, will run out. The remedy for this is added weight on one side of the bowl shell. This location is determined by the balancer by holding a colored pencil in contact with the vibrating spindle and observing the length and location of the resulting pencil mark.

HYDRAULIC SPRING-TESTING MACHINE

By H. A. PEARSON

A machine for testing compression springs by hydraulic pressure is shown in the illustration accompanying this article. The number of pounds pressure exerted on the spring is indicated on a gage, while the deflection of the spring in inches, or fractions thereof, is shown on a graduated scale. Prior to using this appliance, oil is poured into cylinder *A* until space *F* in the bottom of body *B*, and the piping between the cylinder and the body, and between the body and gage *G*, are filled, and the cylinder itself is almost filled. It is, of course, necessary to remove cap *C*, screw *D*, and plunger *E* from the cylinder in order to accomplish this, and sufficient space should be left between the oil level and the top of the cylinder to permit these parts to be replaced without any pressure being registered on the gage.

In testing a spring, plunger *E* is first raised by turning the handwheel on screw *D*. This removes any pressure there may be on the oil, so that piston *H* rests on dowel-pins *I*; with the piston in this position the indicator attached to the plate on the piston points to the zero mark on scale *J*. The spring to be tested is next placed on the plate on piston *H* and plate *K* is lowered, by revolving screw *L*, until the spring is held firmly in place. After screw *L* has been adjusted to suit the spring, nut *N* is screwed tight against the boss on body *B* to prevent the screw from turning when pressure is placed on the spring. Pressure is exerted on the oil by rotating screw *D* so as to force plunger *E* into the cylinder. The pressure exerted on the oil raises piston *H*, thus causing deflection of the spring. The amount of this deflection is read on scale *J*, while the pressure on the oil, and therefore on the spring, is indicated on the gage. A leather washer *M* is attached to the bottom of screw *D* by a steel washer and a small round-head machine screw, to prevent oil from leaking past the plunger.



Testing Appliance on which Pressure applied to Spring is shown on Gage while Deflection is indicated on Graduated Scale

* * *

The saving in coal resulting from the installation of hydroelectric plants to take the place of steam power plants for lighting and power purposes is well illustrated by a statement in a recent *Commerce Report* regarding two hydroelectric power plants situated at Fadalto and Nove, Italy. These plants, which are now capable of producing 20,000 and 8000 horsepower, respectively, are being enlarged so that they will be capable of producing 280,000 additional horsepower. It is estimated that the increase in capacity of these two plants will mean a saving of about 1,000,000 tons of coal in Italy per year.

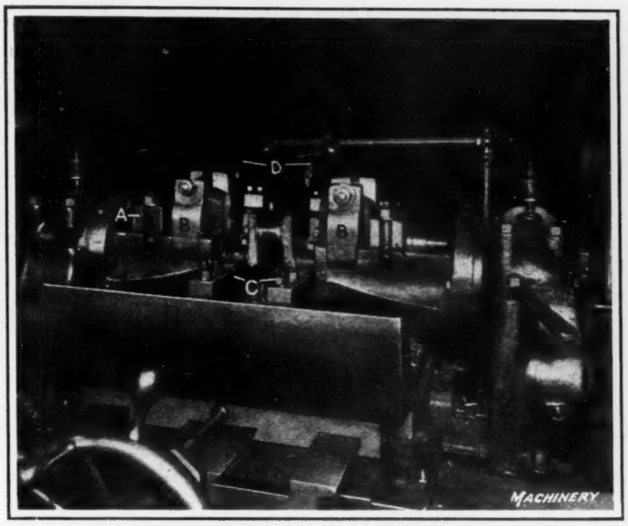


Fig. 1. Lathe equipped with Two Tools for simultaneously turning Two Crankpins on the Essex Crankshafts

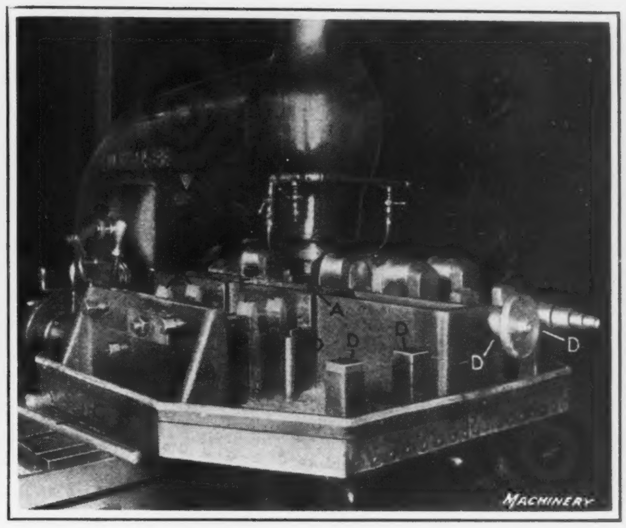


Fig. 2. Vertical Miller equipped with Multiple Fixture for milling Counterweight Seats on Essex Crankshafts

Machining Essex Crankshafts

Methods Used by the Hudson Motor Car Co., Detroit, Mich., in Machining the Crankshafts for the Essex Car

IN working out the design of the four-cylinder motor for the Essex car built by the Hudson Motor Car Co., of Detroit, Mich., many of the general features of the Hudson "Super-six" motor have been retained. As a result, the Essex engine may be referred to as a "Super-four." It is the purpose of this article to describe methods of manufacturing and not to enter into a discussion of motor car engine design; but the features of the Essex crankshaft illustrated in Fig. 3, in connection with the accompanying operation sheet for machine work done on this part, will make it apparent to readers who are familiar with the Hudson engine that the Essex crankshaft is designed along the same general lines. For instance, attention is called to the provision for using counterweights, which give an accurately balanced running action and which enable the engine to operate smoothly and with very little noise. A complete outline of the machine work performed on these parts is presented in tabular form, and these data will be supplemented by detailed descriptions of several of the more interesting operations.

Rough-turning the Crankpins

R. K. Le Blond crankshaft lathes are employed for turning and spacing the crankpins. These lathes are equipped with double toolposts so that provision may be made for simultaneously performing a roughing operation on two pins. Fig. 3 illustrates the crankshaft to be machined, and Fig. 1 shows a lathe tooled up for machining the two center pins. Reference to this illustration will make it apparent that the lathe is equipped with a driving head at each end of the bed, instead of having the usual arrangement of headstock and tailstock. Such an arrangement is considered desirable, owing to the use of two tools that are frequently required to take heavy cuts in tough forgings. With power applied from each end of the machine, there is assurance of a uniform drive, and the amount of torque developed in the work is not as great under such conditions of operation.

It will be noticed that on each of the faceplates of this machine a cat-head is furnished, which grips the work by means of pivoted straps *A*, Fig. 1, that are tightened down on the end bearings *a* and *e*, Fig. 3, and pivoted straps *B* which are secured to the Nos. 1 and 4 crankpins *i* and *j*. The turning tools for operation on the Nos. 2 and 3 crankpins *k* and *l*, are shown at *C* in Fig. 1, and the saving effected through the possibility of simultaneously roughing out two pins will be obvious. On account of the toughness of the work, there is usually danger of the tools being damaged by burning, and to reduce to a minimum the danger of overheating the tools and work, a double lubricant pipe *D* is arranged to deliver a copious flow of coolant to the point of each tool. On this job the tools are operated at a cutting speed of 52 feet per minute, and the actual time for turning and spacing the Nos. 2 and 3 pins is 4.20 minutes.

Milling Seats for the Counterweights

Mention has already been made of the practice of counterweighting the crankshaft of the Essex motor to assure

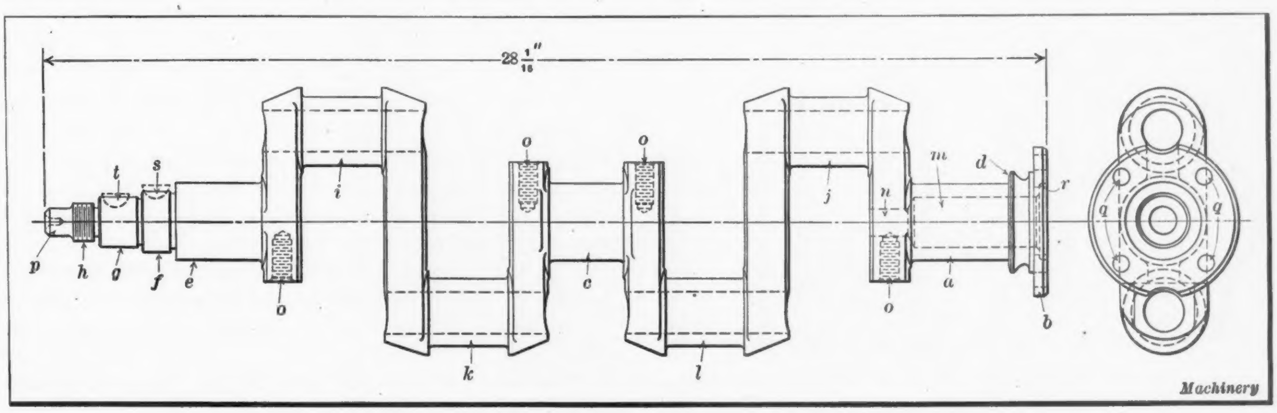


Fig. 3. Crankshaft of the Essex Motor, on which Machining Operations are to be performed

smoothness of operation. For this purpose it is necessary to mill four seats *o* to which the counterweights are attached. A Kearney & Trecker vertical-spindle milling machine is employed, which is equipped with a multiple work-holding fixture that provides for setting up four crankshafts for facing the counterweight seats. Reference to Fig. 2 will make it apparent that the milling fixture is divided at the center by a wall *A*, and in the performance of the milling operations that are required on the counterweight seats, it is the practice to use one-half of the fixture for holding the forgings on which the machine is working while the operator is engaged in removing milled crankshafts from the other side of the fixture and resetting fresh pieces of work in their places.

At each end of the fixture there is a sliding jaw *B* which is moved inward against the work by tightening up the bolts with a socket wrench *C*. In the condition in which the crankshafts come to this machine, the line bearings have been turned, and these partially finished surfaces are used as the locating points. On the fixture there are pads *D* on which the line bearings are supported, and for spacing the individual forgings in the fixture, there are floating wedges *E* that extend upward between the turned bearings on the work. The milling fixture is mounted on a pivotal support so that after the seats at one end of the forgings have been milled, the fixture may be indexed through 180 degrees to bring the counterweight seats at the opposite end of the crankshafts into place under the milling cutter. After milling two of the counterweight seats on each crankshaft forging, it is necessary to remove the forgings from the fixture and reset them for milling the two counterweight seats at the opposite side. On this job the milling cutters are operated at a speed of 75 feet per minute, and the time required to complete milling four counterweight bosses on a forging is 5.35 minutes.

Tapping Holes in Counterweight Seats

Fig. 4 illustrates a convenient equipment for use in tapping the holes *o*, Fig. 3, in counterweight seats, that receive bolts, which secure the weights in place on the crankshaft. This tool consists of a pneumatic drill equipped with a tapping chuck, the entire drill, air hose, etc., being suspended by a cable *A* secured to a counterpoise, so that very little effort is required to feed the tap down into the work or withdraw it after the hole has been threaded. There is nothing unusual about the method of performing this tapping operation, but there is another feature of the way in which the apparatus is arranged that adds greatly to the facility with which the operator is able to perform his work. The holes have already been drilled in the forgings and no special provision has to be made for obtaining an accurate location of the work. As a result, the forging can be dropped into V-blocks *B* that engage the line bearings at each end of the crankshaft. After the holes *o* have been tapped in the two counterweight seats adjacent to the bearings *c* at the center of the shaft, it is merely necessary to turn the shaft through a half turn on its supports to bring the other two counterweight seats into position to tap the holes.

Still another feature of the provision that has been made

ORDER OF MACHINING OPERATIONS ON ESSEX CRANKSHAFTS

Oper. No.	Operation	Type of Equipment	Cut. Speed, Feet per Min.	Prod. Time, Minutes
1	Rough inspection	Bench	....	....
2	Heat-treat	Furnace	....	....
3	Pickle	Acid tank	....	....
4	Sand-blast	Sand-blasting machine	....	....
5	Straighten	Metalwood straightening press	....	....
6	Center both ends	Duplex centering machine	....	....
7	Rough-turn bearing a and outside diameter of flange b, Fig. 3	Wickes engine lathe	58	3.16
8	Rough- and finish-turn and cheek bearing c	LeBlond engine lathe	72	5.25
9	Space flange b and web, space bearing a and form oil thrower d	Wickes engine lathe	83	6.80
10	Face, chamfer, and finish-turn outside diameter of flange b	Wickes engine lathe	80	4.37
11	Face web, space bearing e to length and rough-turn front end	Wickes engine lathe	80	3.00
12	Rough-turn bearing e and fits f, g, and h; space bearing e and neck diameters f, g, and h	Wickes engine lathe	80	3.95
13	Inspect	Bench	....	....
14	Cheek web on all pins	LeBlond crankshaft lathe	125	6.52
15	Spot-turn pins i and j; space to length	LeBlond crankshaft lathe	52	4.20
16	Spot-turn and space pins k and l	LeBlond crankshaft lathe	52	4.20
17	Inspect	Bench	....	....
18	Cut clearance slots in flange	Niles-Bement-Pond drilling machine	40	1.20
19	Mill counterweight bosses	"Milwaukee" milling machine	75	5.35
20	Drill holes m and n through bearing a	Foote-Burt drilling machine	56	6.19
21	Drill eight holes o	Baush multiple drilling machine	35	3.00
22	Countersink and tap eight holes o	Carlton radial drilling machine	60	3.15
23	Drill axial hole through pins k and l	Foote-Burt Vertical drilling machine	40	2.88
24	Drill axial holes through pins i and j	Foote-Burt Vertical drilling machine	40	2.88
25	Wash and blow-out eight holes o	Soda tank and air hose	....	1.25
26	Remove burrs	Bench	....	2.00
27	Straighten	Metalwood pneumatic press	....	2.13
28	Cut to length, re-center both ends, finish-turn fits f, g, and h, and pilot p	Monarch turret lathe	75	3.20
29	Tap eight holes o	Air drill and tapping chuck	....	3.50
30	Rough-grind bearing c	Landis grinding machine	....	....
31	Rough-grind bearings a and e	Landis grinding machine	....	....
32	Rough-grind pins k and l	Landis grinding machine	....	....
33	Rough-grind pins i and j	Landis grinding machine	....	....
34	Finish-grind pins i and j	Landis grinding machine	....	....
35	Finish-grind pins k and l	Landis grinding machine	....	....
36	Straighten to 0.003 inch	Metalwood pneumatic press	....	2.15
37	Inspect	Bench	....	....
38	Finish-grind bearings a, c and e	Landis grinding machine	....	....
39	Finish-grind fits f and g, and pilot p	Landis grinding machine	....	....
40	Finish-grind outside diameter of flange b	Landis grinding machine	....	....
41	Inspect	Bench	....	....
42	Drill and ream holes q in flange	Baush multiple drilling machine	56	4.18
43	Finish-face and chamfer flange b, chamfer hole m and counterbore at r	Monarch turret lathe	76	3.60
44	Finish-space bearing e, and fits f and g, chamfer and thread at h, and finish-turn pilot p	Monarch turret lathe	40	3.53
45	Mill keyways s and t	Special milling machine	35	1.18
46	Remove burrs	Bench	....	2.00
47	Polish bearings a, c and e, and pins i, j, k and l	South Bend lathe	....	3.38
48	Final inspection	Bench	....	....
49	Weld forging defects	Acetylene torch	....	29.00
50	Finish-grind pins i and j after welding	Landis grinding machine	....	....
51	Finish-grind pins k and l after welding	Landis grinding machine	....	....
52	Straighten after welding	Metalwood pneumatic press	....	....
53	Finish-grind bearings a, c, and e after welding	Landis grinding machine	....	....
54	Finish-grind and space fits f, g, and p	Landis grinding machine	....	....

Machinery

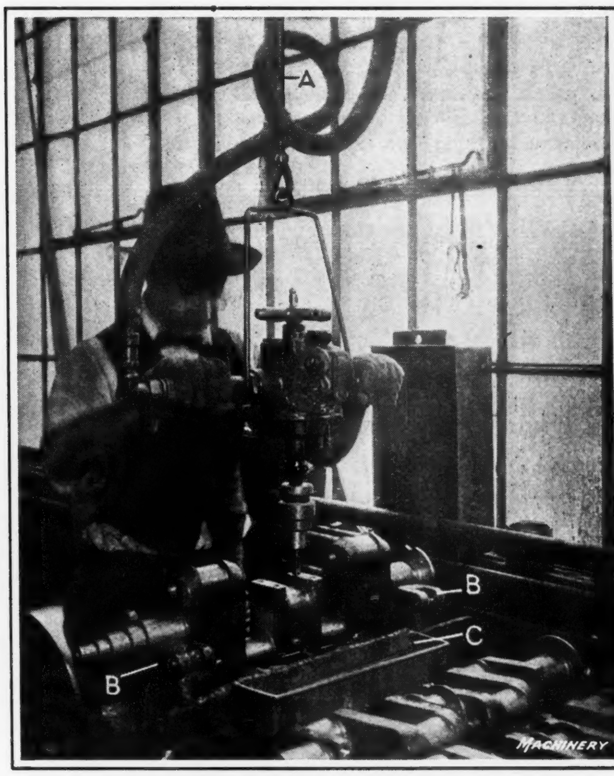


Fig. 4. Conveniently Arranged Air-operated Tool for tapping Holes in the Counterweight Seats on Essex Crankshafts

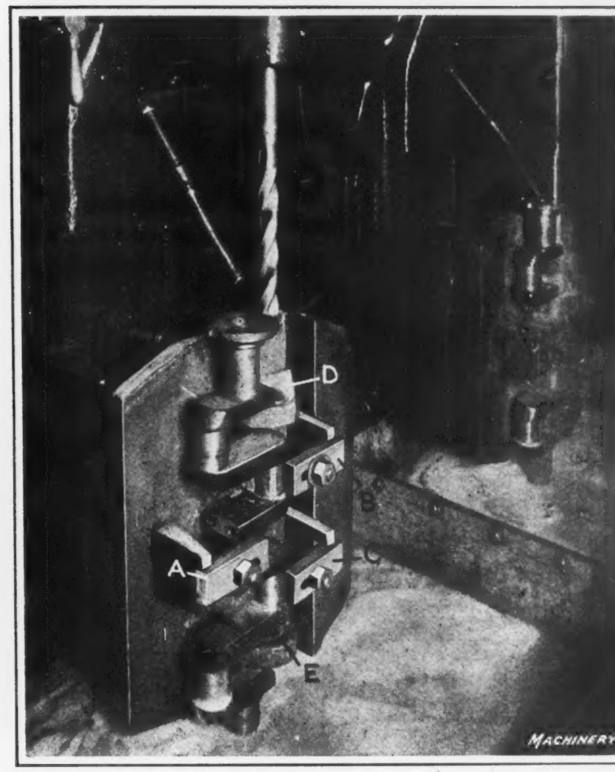


Fig. 5. Drilling Machines provided with Indexing Jigs for drilling Axial Holes through the Crankpins

for the performance of this tapping operation, which adds substantially to the rate of output that can be attained, is the provision of a pan C directly in front of the work-holding fixture. Owing to the toughness of the forgings to be machined, it is found desirable to employ lard oil as a combined coolant and lubricant for preventing undue wear of the tap. Pan C is filled with lard oil, and preparatory to the performance of each tapping operation, the workman dips the point of the tap into the oil, so that it will be covered with a film that is sufficient for tapping one hole. Owing to the counterweighted supporting cable A that carries the tool, little physical effort is required of the workman in lubricating the tap in this way, and such a method of applying oil is very much more rapid than using a small brush to cover the tap with a sufficient quantity to lubricate it during the performance of each tapping operation. For this job the production time is 3.50 minutes for tapping eight holes.

Drilling Axial Holes in Crankpins

In order to provide the necessary projected area for the crankpin bearings, and still avoid having the shaft unduly heavy, a practice is made of drilling an axial hole 1⅛ inches in diameter through each of the pins. Fig. 5 shows two units of a battery of eight Foote-Burt vertical drilling machines which are equipped with indexing jigs to provide for the performance of these drilling operations. In this illustration the machines are shown equipped for drilling holes in the Nos. 2 and 3 crankpins k and l, Fig. 3, but the arrangement for drilling the Nos. 1 and 4 pins i and j is essentially the same. It will be seen that the forging is secured in the fixture by means of three straps A, B, and C, which hold the work back into V-blocks that engage the middle line bearing c and the Nos. 2 and 3 crankpins k and l.

At the top of the jig there will be seen a drill bushing D, Fig. 5, which guides the drill while it is removing the excess metal from the center of crankpin l, and after this result has been accomplished, the drill is withdrawn and a locking pin is pulled back to enable the jig to be indexed through 180 degrees, thus bringing drill bushing E into place under the drill for drilling a similar hole in crankpin k. One operator is able to look after four machines. The drills are driven at a cutting speed of 40 feet per minute, and the time required for drilling holes through the Nos. 2 and 3 crankpins or the Nos. 1 and 4 pins is 2.88 minutes.

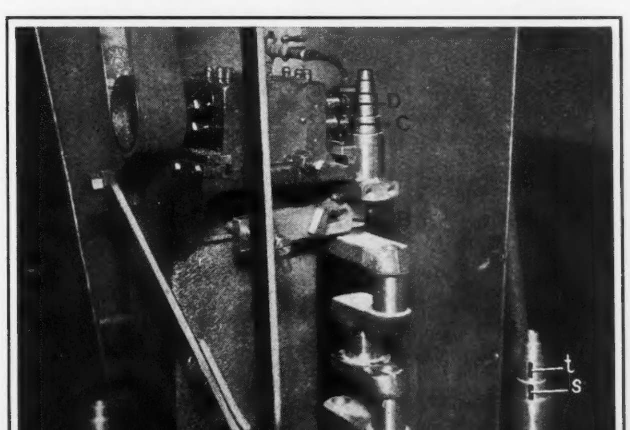


Fig. 6. Special Duplex Milling Machine for Use in milling Keyways s and t in the Essex Crankshafts

On the Essex crankshaft, it is necessary to mill two Woodruff keyways in the gear fit f, Fig. 3, and the fan pulley fit g. Fig. 6 shows a special duplex milling machine which was built for this operation, and two crankshafts are shown standing on end beside the machine, in which the keyways to be milled are clearly shown at s and t. As the work is received at this miller, it has been practically completed, and the holes drilled in the flange b are utilized as locating points, pins on the supporting member A on the fixture entering the flange holes to locate the work. The No. 1 crankpin enters a V-block and is held in place by strap B. Supported in this manner the two keyways are milled in the work simultaneously by cutters C and D. The operation is completed in 1.18 minutes.

A System of Fit Allowances

By SYDNEY B. AUSTIN, Inspection Engineer, The Eisemann Magneto Corporation, Brooklyn, N. Y.

It has been common practice in many drafting-rooms to use the notations "drive fit," "force fit," etc., in connection with dimensioning drawings. This nomenclature frequently leads to confusion and misunderstanding, as there is no definite standard for establishing the meaning of these terms, and to provide for interchangeable manufacture it is necessary that definite dimensions be given in place of these indefinite expressions.

In order to arrive at some understanding of the meaning of these various expressions, and in an effort to determine proper fit allowances and tolerances a study was made of the data given in various mechanical handbooks. The two systems given in most handbooks which seem more nearly to fit the case in point are those of the Brown & Sharpe Mfg. Co. and of the Newall Engineering Co. A study of these two systems shows that in a great many particulars they do not agree, and in some places are quite inconsistent in themselves. However, they were used as a general guide in conducting the investigation, the results of which are presented in this article.

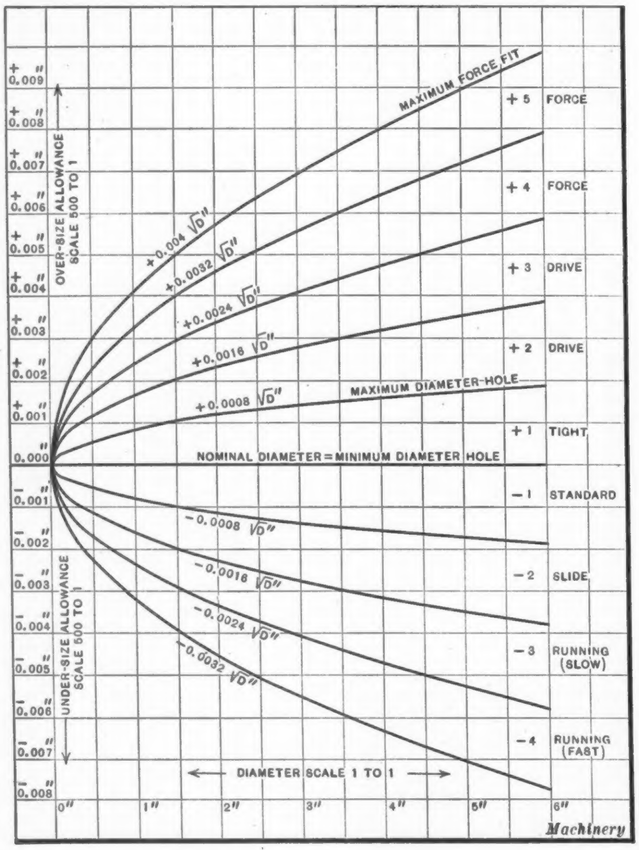


Fig. 1. Curves showing the Relation of Allowances for Fits to Various Diameters

The Hole as the Basic Size

The practice of the Brown & Sharpe Mfg. Co. of making the hole, in all cases, the nominal diameter with a plus tolerance was taken as the basis of the system here suggested. In the Newall system, the hole is given both a plus and a minus limit, but this was considered undesirable for two reasons: In the first place, a standard tolerance for the hole, when adopted for all classes of fits, simplifies the matter of dimensioning drawings considerably, and in the second place it was desired to develop a system of allowances in which the maximum metal dimension could be placed on the drawings with but one limit—plus in the case of holes and minus in the case of male parts.

Establishing a Relation between Fit Allowances and Diameters

In connection with the investigation, it was desired to arrive at a curve or law covering the relation of the allowances for fits to the diameter of the part. For various reasons it seems that this curve should be in the nature of a parabola approaching the horizontal as a limit. The law or equation of the parabola is $y^2 = 2px$, or $y = \sqrt{2px}$. This would indicate that the allowance for fits should be a function of the square root of the diameter; in fact, the Newall Engineering Co.'s tables give equations for the hole tolerances and limits for running fits based on this law of the parabola. It was also found that the values given in the Brown & Sharpe tables follow this law very closely.

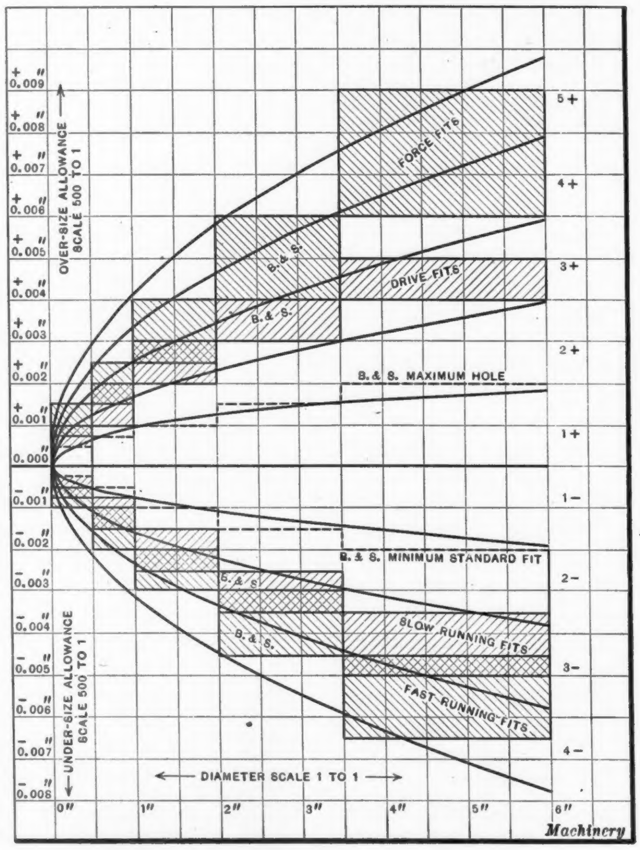


Fig. 2. Comparison of Theoretical Curves with B. & S. System of Fit Allowances

The equation for the tolerance on the hole, $y = 0.0008\sqrt{D}$, also taken as the basis, in which y represents the tolerance and D the diameter of the hole, corresponds almost exactly with the Brown & Sharpe hole tolerance and also very closely with that given by Newall. This curve, also other curves, the ordinates of which are multiples of the ordinate used in plotting the original curve, were laid out both above and below the horizontal axis. Each of these lines is intended to be the upper limit of one and the lower limit of another class of fit, and these fits, for the purpose of discussion, will be designated by plus numerals or minus numerals, as the case may be. These curves are shown in Fig. 1, and were originally drawn full scale for the diameters and to a scale of 1 to 500 for tolerance allowances, that is, ½ inch equals

0.001 inch. Although the original scale is reduced in the illustrations, the proportions, of course, remain the same. The same curves can be used for the metric system by using a scale of centimeters, in which case ½ centimeter equals 0.01 millimeter. The equation for hole tolerance when expressed in the metric system may be written $y = 0.004 \sqrt{D}$.

Comparison of Curves with Allowances Given in Brown & Sharpe Tables

The comparison of the curves shown in Fig. 1 with the values given in the Brown & Sharpe tables is shown in Fig. 2. The No. 1 plus fit, having the same limits as the Brown & Sharpe grinding limits for holes, will produce a size and size fit, or what is sometimes designated as a wringing fit. In extreme cases where the maximum limit is approached by one part and the minimum limit by the other, there will, of course, be produced an over-size or an undersize fit, but the clearance or interference, as the case may be, will be very slight.

The No. 2 plus fit might be called a very light drive fit, as it comes between the size of the hole and the minimum limit of the Brown & Sharpe drive fit. The No. 3 plus fit corresponds almost exactly with the Brown & Sharpe allowance for a drive fit. The Brown & Sharpe system allows but one value for a large range of diameters, and it is therefore necessary in the case of diameters from 3½ to 6 inches, to make the limits small in order to keep within the boundaries, that is, below the minimum for 6 inches or above the maximum for 3½ inches. This tolerance in the Brown & Sharpe tables is therefore only 0.001 inch for the ordinary class of work, whereas on the curves shown in the accompanying illustrations this allowance is nearly doubled.

The next two plus fits, Nos. 4 and 5, agree with the range covered by the Brown & Sharpe force fits, but do not go quite as far in the oversize allowance as the Newall force fits (see Fig. 3). In a similar manner, the clearance or minus fits of Fig. 1 are seen to correspond very closely with the Brown & Sharpe fits. No. 1 very nearly agrees with the Brown & Sharpe "standard," or what is sometimes classified as push fit; No. 2 represents a fit between the Brown & Sharpe standard and the "slow" or ordinary running fit, and might be referred to under the present nomenclature as "sliding fit"; Nos. 3 and 4 correspond with the regular Brown & Sharpe running fits. Brown & Sharpe also give a sliding fit which is almost identical with the slow running fit and therefore is not shown in Fig. 2.

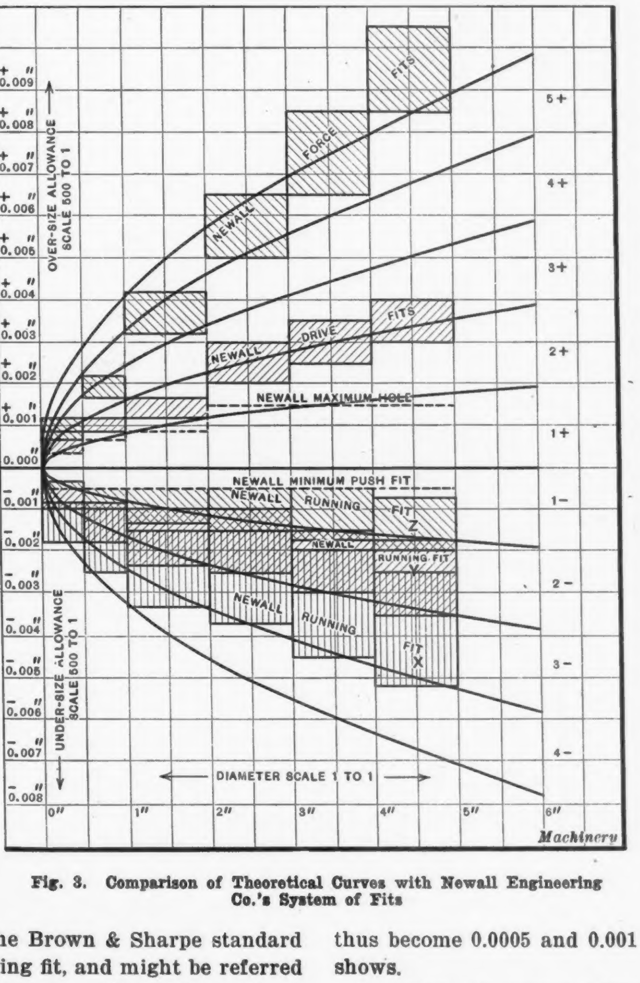


Fig. 3. Comparison of Theoretical Curves with Newall Engineering Co.'s System of Fits

Comparison of Curves with Newall Fit Allowances

The relation of the Newall nomenclature to these curves is shown in Fig. 3. In making this comparison on the same basis as was employed in comparing the curves with the Brown & Sharpe system, the Newall values were corrected by the amount of the minus tolerance. This was necessary, since the minimum size of the hole is taken as the basis both in the Brown & Sharpe system and in the system here described. The values shown in Fig. 3 are not therefore the values given in the Newall tables, but are the differences between the particular size in question and the minimum size of the holes; that is, since the minimum hole up to 2 inches in diameter has a low limit of —0.0002 inch and a low limit of —0.0005 inch for diameters over 2 inches, in plotting, the positive values are increased by the amounts of these minus values. For example, the Newall maximum hole for ½-inch diameters will have a tolerance of 0.0004 inch; for diameters up to and including 1 inch, a tolerance of 0.0007 inch; for diameters up to and including 2 inches, a tolerance of 0.0009 inch, etc. These are indicated on the illustration by dotted lines.

In similar manner, the negative values obtained from the plotted curves will represent a decrease for each diameter equal to these same minus tolerances on the hole. For example, the Newall limit for a minimum push fit is —0.0007 inch up to and including 2-inch diameters, and —0.001 inch for diameters greater than 2 inches, in all cases 0.0005 inch smaller than the minimum hole. This accounts for the minus allowance for a minimum push fit being 0.0005 inch throughout, as indicated by the dotted line. The plotted areas in the lower part of this illustration will be seen to overlap considerably and consequently are liable to cause some confusion unless it is borne in mind that the allowances, for the purpose of comparison, are re-established on a minimum hole tolerance basis. The Newall running fit Z has limits of —0.0005 inch and —0.0007 inch for ½-inch diameters and —0.0007 and —0.0012 inch limits for diameters up to 1 inch, and so on, so that in plotting the areas these values must each be reduced an amount equal to the minus tolerance on the hole, that is, 0.0002 inch for holes up to and including 2 inches in diameter, and 0.0005 for the larger holes. This accounts for the limits of 0.0003 and 0.0005 inch for the ½-inch diameters, and 0.0005 and 0.001 for the diameters up to and including 1 inch. By referring to the Newall tables and remembering that the values given are reduced in amount equal to the minus tolerance on the hole, the plotted areas may be readily checked. In the running fit Y, the minus limits 0.0007 and 0.0012 inch thus become 0.0005 and 0.001 inch, respectively, as the chart shows.

In using the curves shown in these charts, it is not intended to introduce a new system of nomenclature for fits (even though some confusion is liable to result from the use of the common method of referring to various fits), the purpose being merely to furnish a system that may be used as a guide in determining sizes and tolerances.

How Allowances should be Determined by the Draftsman

The method of using the charts is as follows: The draftsman should determine in a general way the approximate class of fit required, and should enter on the drawing simply the maximum metal dimension; this will determine the class of fit. In the case of the hole this will be the nominal diameter. The maximum diameter of the shaft or other male member will be determined by reference to these curves.

The drawing should be sent to the shop without the limit so that the amount of tolerance can be determined by practical manufacturing considerations and the functioning requirements of the apparatus. It is, of course, possible for the draftsman to use the limits taken directly from these curves, but it is believed that if this is done it will result in using, at least in a great many instances, closer limits than are required. For economical manufacture, the tolerance should be as liberal as possible, all requirements being taken into consideration.

The allowances shown in Fig. 1 are suitable for high-class accurate work, and correspond closely with those used by the Eisemann Magneto Corporation for parts of apparatus which have the more accurate requirements, such as the driving fit for ball bearings on shafts. In this system it is intended, as previously stated, that the maximum metal dimension should first be determined; or in other words, the fit should be classified by the initial clearance between the maximum metal dimensions. In cases of work not requiring such close tolerances, the allowances for both the holes and the shafts may be proportionately greater. It is suggested that for ordinarily accurate machine work about 50 per cent more tolerance could be allowed, so that the tolerance equation would be $y = 0.0012 \sqrt{D}$ for the English measurement system and $y = 0.006 \sqrt{D}$ for the metric system. In these equations, y represents the tolerance and D the diameter in inches, or millimeters, according to the system in use. For the general class of machine work this tolerance may be still further increased.

In all cases when determining tolerances, the method of doing the work and the machine on which the work is to be done should be taken into consideration. In many instances where small diameters are involved, it will be found that the capability of the methods or machines used will require tolerances so large that the variations of the parts within the tolerances cover two or more classes of fits, as ordinarily understood, whereas if the fits are classified by the initial clearance or difference between the maximum metal dimensions, something more definite is available from which to work when establishing the fits. This method seems to be the correct one of classifying fits, because the maximum metal dimensions are the vital ones; that is, it is understood if a dimension is given as 1 inch, plus 0.005 inch tolerance, that a 1-inch hole is what is wanted, but that it may be over size not exceeding 0.005 inch.

A comparison between the results as given by these curves and the values given in the handbooks for rougher classes of work is difficult to make, as there is a wide variation in the allowances given for drive fits, force fits, etc. However, a comparison of a few of the values for the larger diameters with the practice of C. W. Hunt Co., Russell Engine Co., General Electric Co., etc., shows that none of these practices disagree more with the system here described than they do with each other.

* * *

FRENCH FOREIGN TRADE BUREAU

The French Foreign Trade Bureau, known as the "Office du Commerce Exterieur" has recently been reorganized to increase its scope. This department controls the service of French commercial agents, and is responsible for organizing trade exhibits in France and other countries. It supplies trade information in the form of loose-leaf pamphlets or in response to inquiries, and helps foreign traders who are seeking information as to the French market. Plans are being made to hold a commercial exhibition in Canada, a colonial exhibition at Marseilles in 1922, and an inter-allied exhibition in Paris in 1925. Permanent exhibitions are being provided for branch offices of the department in the principal countries of the world, exhibitions already having been opened in Spain, Switzerland, Czecho-Slovakia, the Balkan States, and in London, England. The department intends soon to begin the publication of a periodical similar to the British Board of Trade Journal.

ADAPTING THE SHAPER TO PLANER WORK

The possibility of equipping a shaper for operations ordinarily handled on a planer is brought out in an interesting manner in Fig. 2, where a shaper is shown in use in the Gould & Eberhardt shop at Newark, N. J., for machining the slides for the outer support castings of gear-hobbing machines. This is a 28-inch shaper equipped with a heavy outboard support A, which is bolted to the base of the machine and which affords rigid support for the large box fixture in which the work is secured while the shaping operation is being performed.

The fixture is bolted to the saddle of the shaper, utilizing the regular T-slots in that member, and has a foot with a V-groove for the supporting casting rail. This enables the fixture to be adjusted laterally on the saddle while the different surfaces of the slide are being finished, and insures the fixture being held parallel with the travel of the shaper ram. The work may thus be located in this box fixture without danger of inaccuracies occurring through sag of the fixture. The work B is secured in place by means of binder screws which hold it sidewise. These screws are located on the opposite side of the fixture and so cannot be seen in the illustration, but it will be noted that a draw-bolt C at the foot end of the fixture is provided for securing the work at the base.

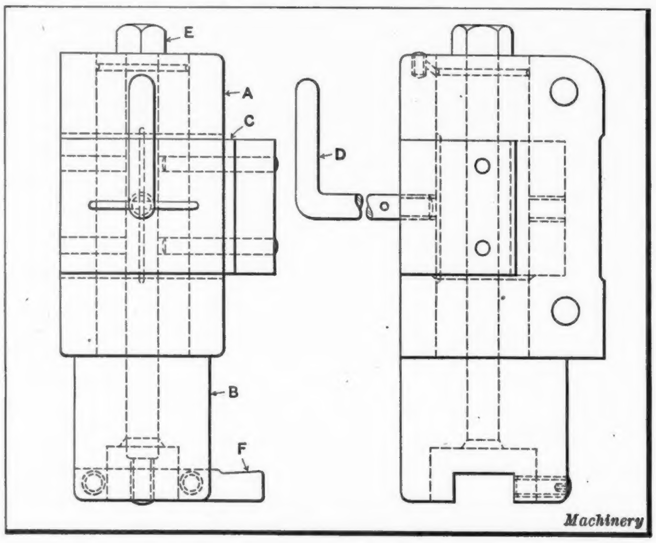


Fig. 1. Side Swiveling Toolpost for Use in planing Under Surfaces

A master gage-block D is provided for obtaining the proper distance from the cutting edge of the tool to the finished surface of the work. The gear-hobbing machines on which these outer supports are used are built in a number of sizes, so that it was necessary to design the fixture so that all castings of this type could be machined in it. To this end the fixture is made long enough to accommodate the largest outer support casting and has a removable base E, the inside of which is machined to fit the previously finished base of the work. To accommodate shorter castings it is merely necessary to change the base for one having a longer finished projection or block, which will fit the machined base of the smaller size outer support casting.

Aside from the features of the fixture described in the foregoing, and the fact that work of this type is not commonly machined on a shaper, the only other point of especial interest that might be referred to in connection with this job is the use of a special tool-holder for finishing the under side of the slides. Ordinarily, a hook tool would be used for an operation of this kind, but in this case a special side-swiveling tool-holder or "flapper" is employed. This tool-holder, which is shown in Fig. 2 at F, is carried on the tool-head of the shaper, being hung to the regular toolpost block by means of two pins. Fig. 1 is an assembled view of this

tool-holder, which consists of a holder *A* secured to the tool-post block of the shaper, a toolpost *B* which is free to swivel in the holder, a yoke *C* which is fastened by pins to the toolpost, a handle *D* carried in the yoke by means of which the tool is swiveled, a draw-bolt *E*, and a side cutting planer tool *F*.

The operator sets the tool by means of the master block or gage *D*, Fig. 2, regulating the stroke of the machine so that it will clear the work at both ends and at the same time allow a sufficient space on the back stroke between the end of the slide and the master block to enable the tool to be swiveled 90 degrees. During the finishing of this under surface, the operator stands with his hand on the handle of the tool-holder with the tool in the position shown in the illustration. At the end of the forward stroke he quickly swivels the tool to the front 90 degrees, enabling it to clear the work on the return stroke, at the end of which it is swung back to the right, and this procedure is followed throughout the operation, or until the tool has fed in to the full depth of the under surface of the slide. This type of tool is more satisfactory than a hook tool for work of this kind, since the stiffness of the tool prevents it from springing away from the surface while in operation.

In addition to the master gage *D*, three working gages are used to test the accuracy of the work as it is being machined. Two of these gages are shown lying on the casting at *G* and *H*. Gage *G* is used to test the angle of the side in respect to a horizontal plane. Gage *H* tests the angularity of the two sides of the slide with respect to each other, that is, the included angle, and is simply laid on the work like an ordinary profile gage. Another gage which is shown lying across the top surfaces of the slide enables the parallelism of the top surfaces and the angularity of the two side surfaces to be inspected.

This shaper is one of Gould & Eberhardt's manufacture, and was originally pressed into service to relieve the planing department. However, as the results obtained, both in regard to quality of work and saving of time, were so satisfactory, the job is now regularly performed on the shaper. It requires about fifteen minutes to swing the casting from the floor into the fixture, fasten it in place, and adjust the fixture on the supporting rail preparatory to machining the top surface. In machining the work prior to shaping the under side, a roughing and a finishing cut are taken on the top and angular surfaces of the work with regular tooling equipment. The total time from floor to floor is about three hours, which is a saving over the planer method of about two hours per casting.

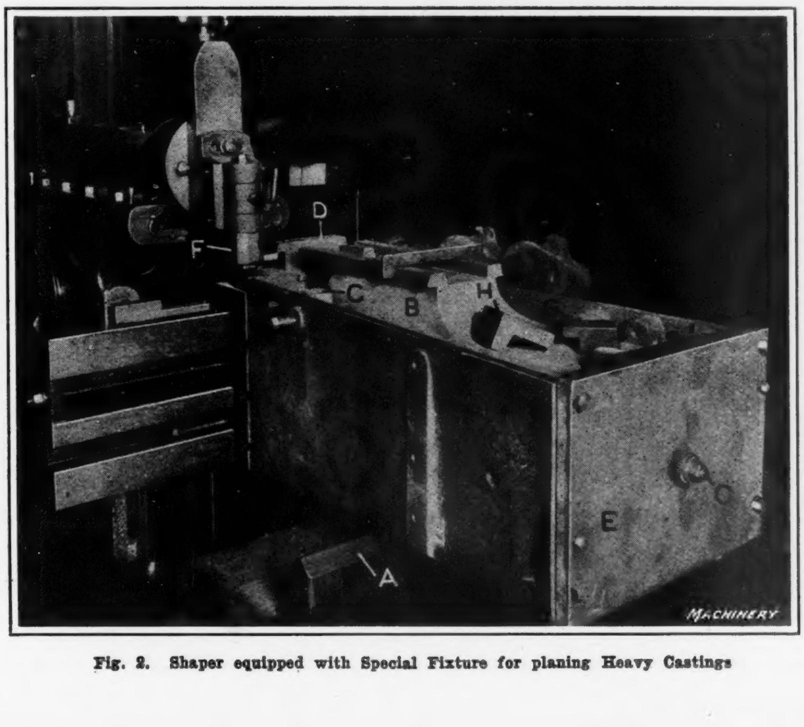


Fig. 2. Shaper equipped with Special Fixture for planing Heavy Castings

MECHANICAL BELT SHIFTER

The difficulty of shifting a belt from one step of a cone pulley to another without some form of belt-shifting device is well known to machinists and machine operators. The

Mechanical Belt Shifter applied to a Milling Machine

use of a belt pole is awkward, but is often necessary when nothing better has been provided. An excellent type of mechanical belt shifter is shown in the accompanying illustration applied to a milling machine. This belt shifter was designed for use in the plant of the H. H. Franklin Mfg. Co., Syracuse, N. Y., by the tool design section. It has a lower member for shifting the machine end of the belt, and an upper part for shifting the countershaft end. The lower member consists of a rectangular bar that is fixed in its supports and carries a sliding yoke through which the belt passes. A knob or handle is provided for sliding this yoke when shifting the belt. The upper belt yoke has attached to it cords which hang down within reach of the operator and have handles at the lower ends. By pulling one of these cords, the upper yoke is shifted either to the right or the left, depending upon which cord is pulled. The illustration shows a workman about to shift the belt from the largest and the smallest steps of the two cone pulleys to the intermediate steps. By pulling the right-hand cord, the belt is first run off the large step above, and then by sliding the lower bar to the right, the belt is pushed on the intermediate step of the lower cone pulley. To place the belt back in the high-speed position, this order is reversed; that is, the lower end is first pushed from the intermediate step to the smallest step, and then the upper end is run on the largest step by pulling the left-hand cord. These movements, which are controlled by both hands, follow quickly, and the belt is shifted easily and without danger, to any desired position. The shifter is made of standard cold-rolled stock and simple castings which require little machine work.

Machining Car-wheel Borer Frames

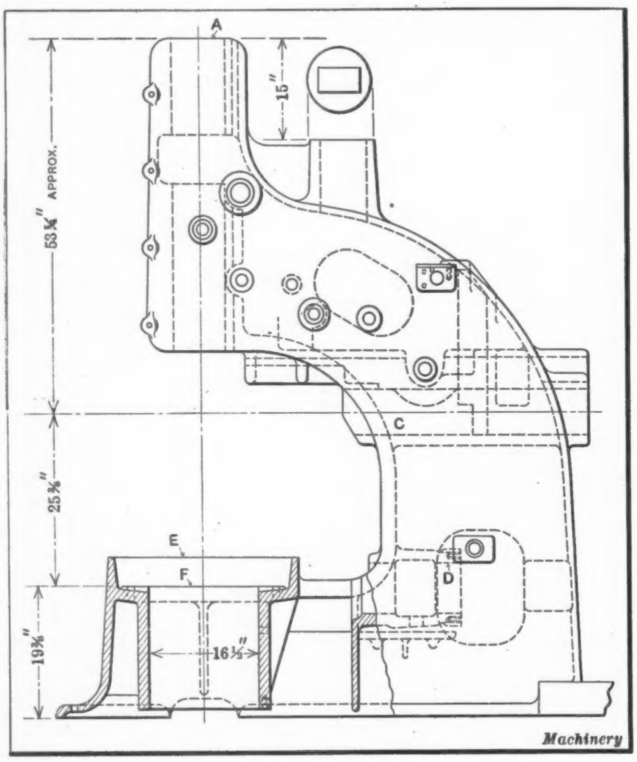


Fig. 1. Car-wheel Borer Frame machined on Floor Platen with Portable Motor-driven Tools

THE large car-wheel boring machine frame shown in detail in Fig. 1 is approximately 98 inches high and of such bulk that it cannot be conveniently handled when machining except by the use of portable tools. Figs. 2 and 3 show the casting set up for the boring, reaming, and rough-facing operations, while Fig. 4 shows the method of finish-facing surface *F*, Fig. 1, with the work anchored in a vertical position. The operations performed in the set-up illustrated in Figs. 2 and 3 consist of boring and reaming the vertical spindle hole *A*, Fig. 1, the facing-ram hole *C*, and hole *D*, as well as rough-facing surfaces *E* and *F*. The work is set up on a floor platen supported by screw-jacks and braced by angle-plates, being anchored in place by means of a number of U-clamps, as clearly illustrated in Fig. 3.

The boring-bar and feed-screw, by means of which the boring tool is traversed along the bar, are shown in Fig. 2. This bar is employed in boring the vertical spindle hole to a diameter of 8 inches. The bar is driven by a motor located near the base end of the frame. This boring-bar is also utilized when reaming this hole, a shell reamer being employed so that it is not necessary to change the set-up. Simultaneously with the boring of the main spindle hole *A*, holes *C* and *D*, Fig. 1, are bored as shown in Fig. 3. In this illustration the boring-bars are shown set up in readiness for performing this operation. A separate motor is employed to drive each of the boring-bars used in boring these two holes, so that there are three motors in simultaneous operation during the boring of these three holes *A*, *C*, and *D*. These holes are also reamed with shell reamers carried on the boring-bars, after the general method employed in reaming the vertical shaft hole. The well-known star-wheel and feed-screw arrangement is used for traversing the boring tool along the bar.

Referring again to Fig. 2, it will be seen that the boring-bar carries a worm-driven cross-screw arm *A*, for performing the rough-facing operations on surfaces *E* and *F*, Fig. 1. This arm carries a cross-feed screw with a star-wheel (clearly shown in the illustration) at each end, the screw being turned sufficiently by engaging finger *B*, to feed the facing tool radially outward from the center at the proper feed per revolution of the arm. During these facing operations another motor is used to drive the facing arm *A*. This illustration also shows the method used to locate the casting from this side, there being a large angle-plate employed to furnish a rigid abutment for the work. The time required to perform these operations, including setting up the work, is eighteen hours.

The finish-facing of surface *F*, Fig. 1, which must be machined accurately and at 90 degrees to the vertical spindle hole *A*, is performed on the erecting floor, the operation being illustrated in Fig. 4. The regular boring machine spindle, which accurately fits the previously machined hole *A*, is employed. A facing ram carries the cross-feed head with its feed-screw and star-wheel, as shown in the illustration. By this means the desired degree of accuracy is established. The spindle carrying the facing ram and head is driven by a motor, as indicated by the driving belt and the pulley attached near the top of the spindle. The degree of accuracy resulting from this method of finish-facing the important surface *F*, which is the seat for the member in which the table of the machine rotates, reduces the amount of fitting and scraping, necessary in assembling, to a min-

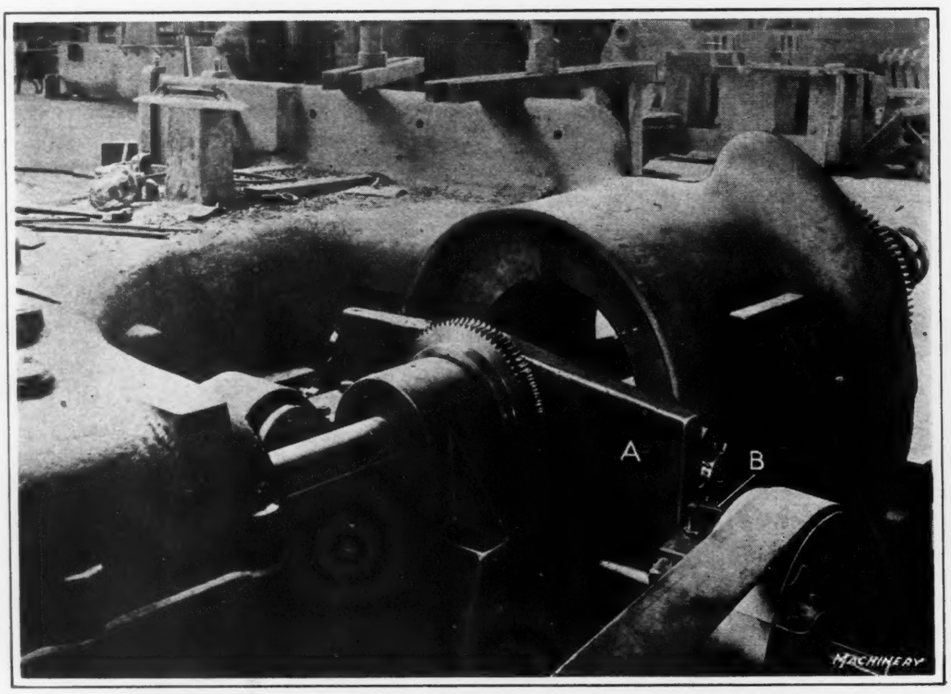


Fig. 2. Star-wheel Feed Mechanism set up for facing Seat on Frame Casting

imum. The methods of performing the several operations here described assure the proper relationship of the finished surfaces, and illustrate the fact that where it is required to handle unwieldy work that cannot be accommodated on standard machines, satisfactory results may be obtained by employing some such out-of-the-ordinary set-ups as those described in this article. The car-wheel boring machine here illustrated is manufactured by the Putnam Machine Works, Fitchburg, Mass.

* * *

CUTTING CAST IRON BY THE TORCH

The Oxweld blowpipe was not originally designed with a view to cutting cast iron, but after exhaustive experiments, a method of operating the torch for cutting cast iron was developed, and it can be mastered, it is stated, by the average operator almost as easily as the method employed for cutting steel. There is, however, a decided difference in respect to procedure. In practice, the cutting of cast iron with the Oxweld blowpipe differs from the cutting of steel in that: (1) It is necessary to use heating flames having an excess of acetylene; (2) it is necessary to hold the blowpipe nozzle farther away from the metal; (3) it is necessary to preheat for a longer period for cast iron than for steel, since the cast iron must be almost molten before the cutting reaction will start. Steel ignites at a temperature well below its melting point; (4) it is necessary to oscillate the nozzle continually to maintain the cut.

A cut in cast iron, if properly handled, and if the material is of good quality, will have an appearance about equal to that of a fair cut in steel. The time required for cutting a given section of cast iron is about twice that required for cutting a similar section of steel. This makes the cost considerably higher in the instance of cast iron and tends to restrict its applications in many places where one might suppose it would be generally useful. For example, the inexpensive methods employed for removing risers from castings in iron foundries preclude the use of oxy-acetylene as an economical means of performing this class of work. Further, the cutting off of risers from chilled castings is usually not practical because the surfaces cut are likely to crack or check, due to local heating. Cast-iron cutting is now used in several industries for removing broken machinery parts such as pinions, gears, flywheels, housings, etc.

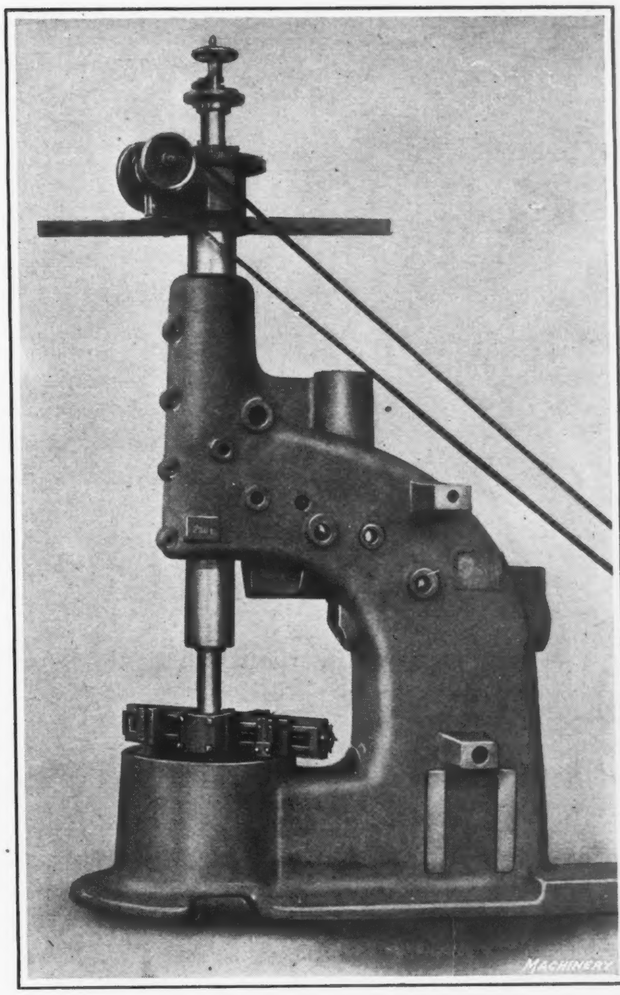


Fig. 4. Finish-facing Operation on Car-wheel Borer Frames, using Regular Machine Spindle for supporting the Facing Head

BRITISH INDUSTRIES FAIR

The greatest annual trade fair in the world, the British Industries Fair, is to be held at London and Birmingham from February 21 to March 4, and at Glasgow from February 28 to March 11. The procedure followed in other years will be the same, except that the fair is to be considerably enlarged. As usual at Birmingham will be exhibited, among other things, machinery and tools of all kinds from the most representative manufacturers of the United Kingdom. The Aerdrome at Castle Bromwich will be used again for this division. Special staffs are maintained to enable buyers to obtain authentic information on all points of importance such as tariffs, shipping and transport, most likely sources of supply, not only of articles included in the fair but also of all British products. Admission will be by invitation only so that bona fide visitors and buyers may have all the attention of exhibitors. The British Consulate General, 44 Whitehall St., New York City, will be glad to issue cards of invitation, and also to give all possible information and assistance to anyone who may desire to attend this fair.

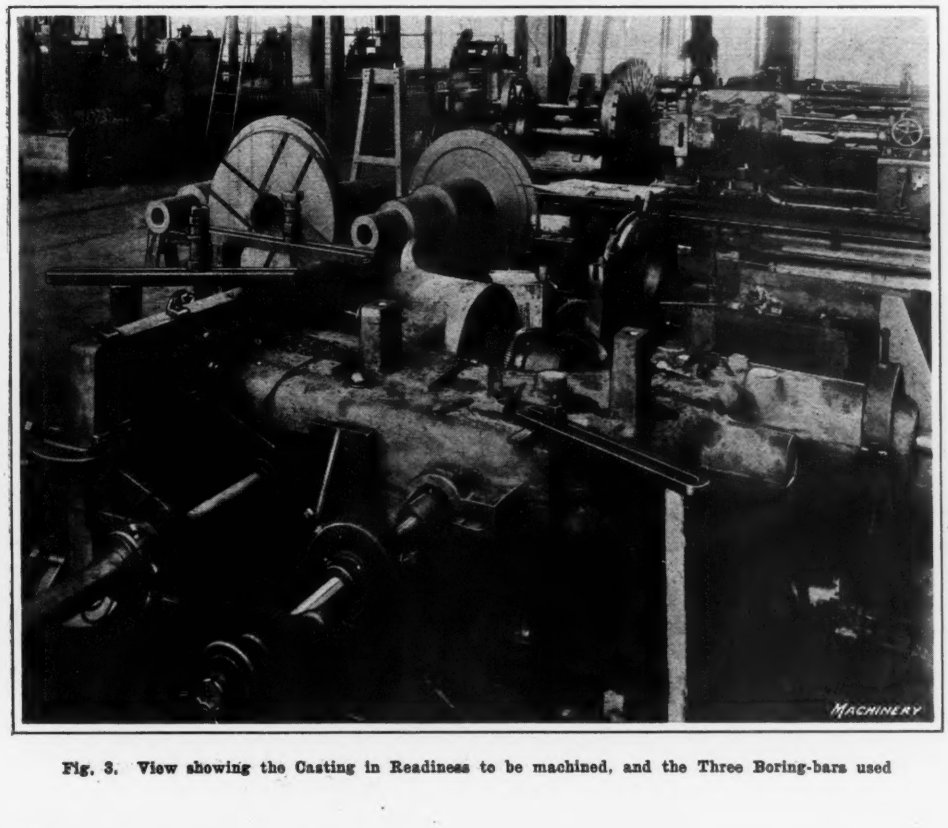
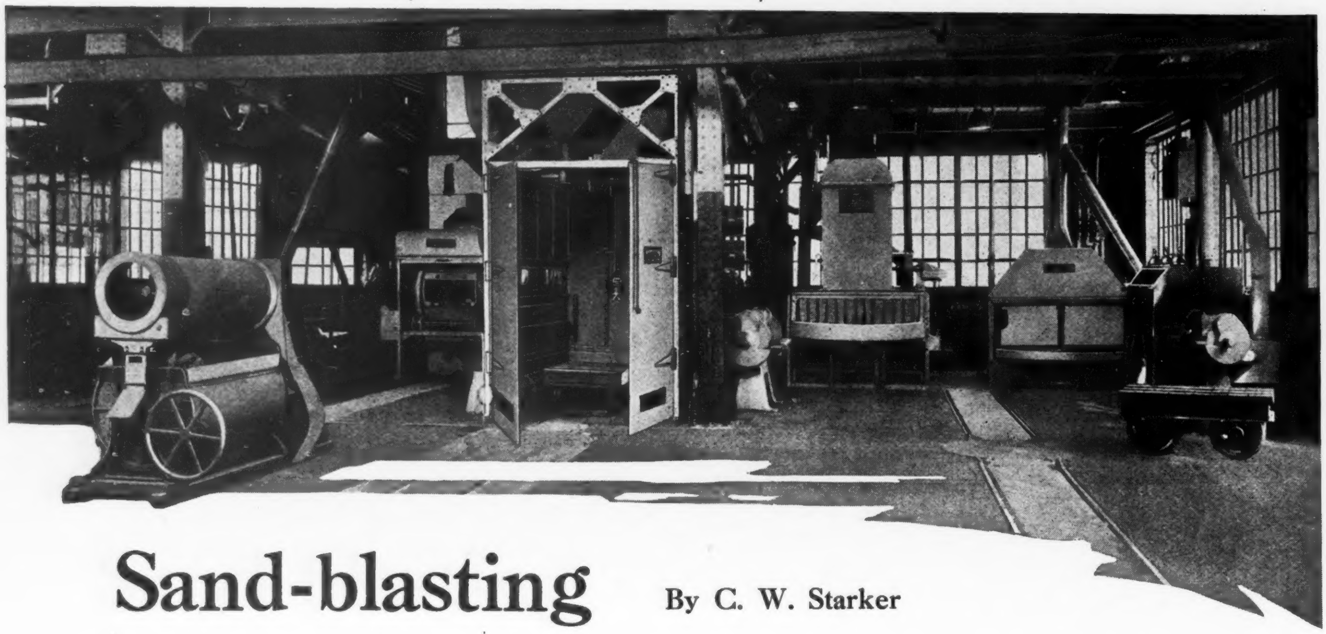


Fig. 3. View showing the Casting in Readiness to be machined, and the Three Boring-bars used



Sand-blasting

By C. W. Starker

Types of Apparatus, Abrasives, Nozzles, Air Pressures, Dust Exhausting, etc.

SAND-BLASTING, while not a new process, still offers great possibilities for a wider application. In order to obtain satisfactory results, a clear understanding is required of a number of features peculiar to the process. In this article concrete data are given in regard to types of apparatus, abrasives, nozzles, air pressures, dust exhausting, etc. The sand-blasting process is best known as a method employed in the iron foundry for cleaning castings, but it actually finds a very much broader and ever-increasing application in all kinds of industries. It is successfully used, not only in cleaning iron and steel castings, but also for brass and aluminum, when the pressure and nozzles are properly adapted to these softer materials. Sheet-metal parts are frequently prepared for plating, galvanizing, enameling, or painting by sand-blasting. The process is also employed for matt-surfacing metals, roughing handles of instruments, lettering or frosting glass, lettering marble, blasting wood for the purpose of bringing out the grain, and many other uses too numerous to mention here.

There are several systems of sand-blasting. They all discharge the abrasive through one or several nozzles, but the manner of applying the stream of abrasive to the surface to be treated varies in different systems, so as to meet the varying conditions and requirements. From the viewpoint of the user, a selection should be made upon consideration of first cost and the cost of operation, in order to secure the best results with the greatest economy. Air, compressed to varying pressures, is commonly employed in all sand-blasting equipments, but the pressure is applied in different ways. The three systems in use are generally designated as the direct-pressure system, the suction or syphon system, and the gravity system. In the direct-pressure system the air and the abrasive are combined in and discharged from a closed tank through a nozzle. The most common example of this system is the hose sand-blasting machine illustrated in Fig. 4, made by the Pangborn Corporation, Hagerstown, Md. The abrasive, under pressure in the sand chamber of the machine, is discharged at full pressure together with the

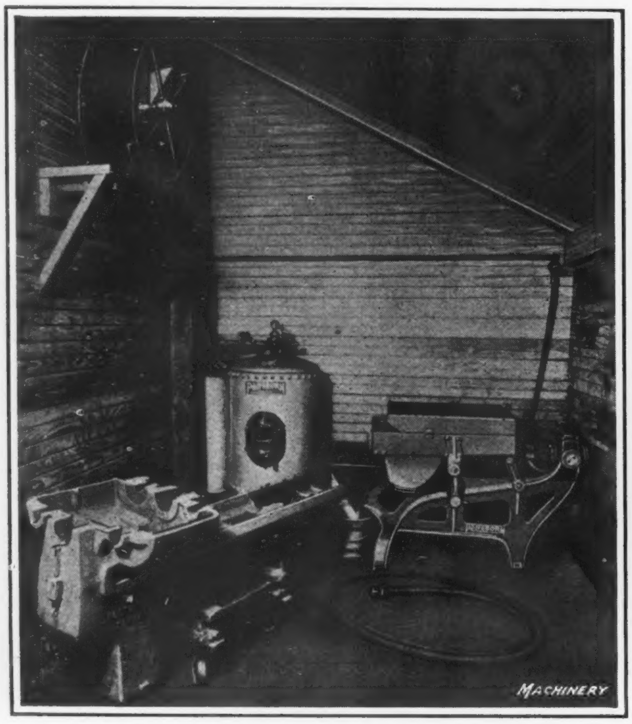


Fig. 1. Sand-blast Room with Hose Machine, Sand Separator, and Wall Fan

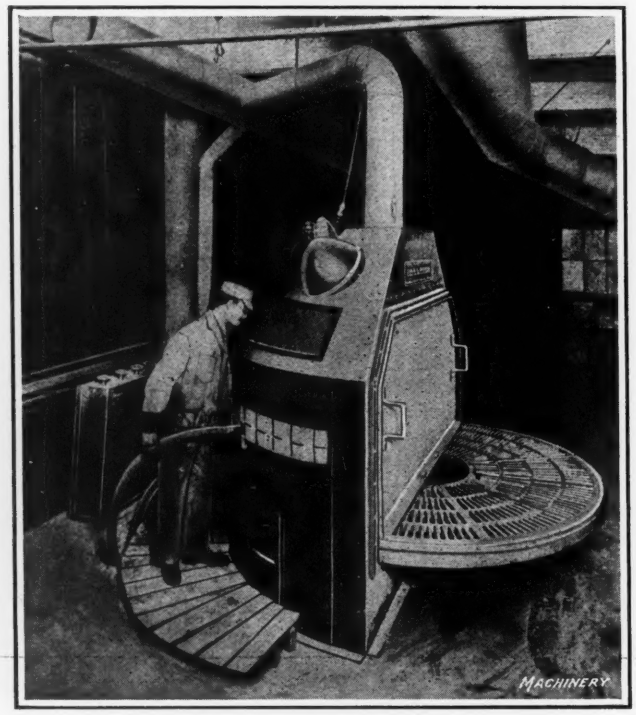


Fig. 2. Sand-blast Cabinet with Provision for operating Hose from Outside

air, thereby attaining the highest possible velocity. This machine will be referred to again in describing the sand-blasting equipment.

In the suction system, the abrasive is carried to the nozzle by a suction created by a jet of compressed air, which, in passing through the nozzle, carries the abrasive with it. The construction is shown diagrammatically in Fig. 5, this apparatus being known as a "sand-blast gun." This gun, as we will see later, may be stationary; may be operated by hand; or may be arranged to travel mechanically across the work to be cleaned, moving either in a straight line, in a circle, or in an oscillating manner, so as to permit the air to act on all sides of an article. A characteristic of this suction system is that the discharge pressure is below the full gage pressure, which results in decreased velocity of the abrasive. This is due to the fact that the air, upon coming out of the air orifice, expands in volume and as a consequence decreases in pressure, since the discharge nozzle of the apparatus must, of course, be larger than the air jet.

In the gravity system, the abrasive is carried by mechanical means to a place above the nozzle and is fed down by gravity. At the nozzle, the abrasive and compressed air combine and are discharged. The full energy of the compressed air is imparted to the abrasive, but in this system also the air jet is smaller than the discharge nozzle, and therefore expansion of the air takes place.

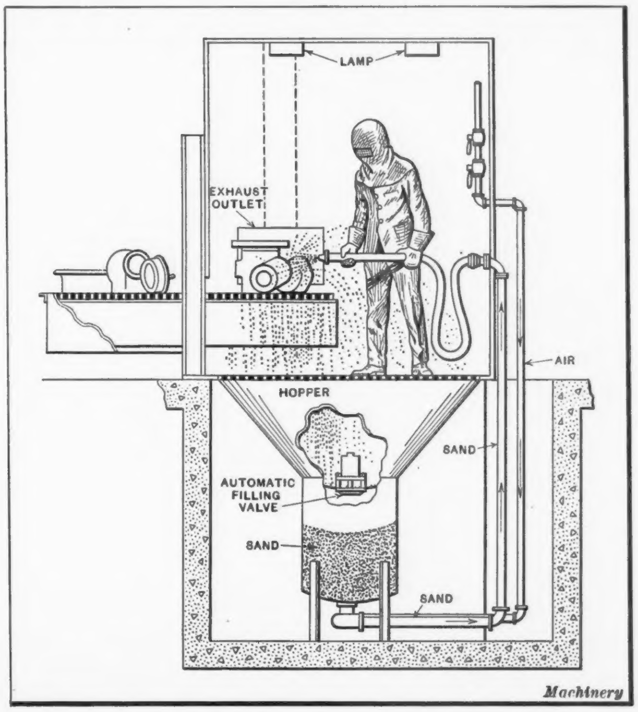


Fig. 3. Sand-blast Room with Machine located underneath the Room

These three different systems naturally result in a variety of constructions, but before going into these it is well to take note of the basic factors that govern all forms of sand-blasting, and these should be carefully considered before selecting equipment. Familiarity with these factors and the proper application to installed equipment are necessary in order to secure the greatest economy and the best results.

The pressure and volume of air are two factors of sand-blasting which should be kept in mind. It may be said, other things being equal, that the higher the air pressure used the stronger the force of the jet discharged against the surface to be treated and, therefore, the greater the amount of work done. Consequently, for hard scale on steel, a higher pressure is advisable, for example, than for cleaning a soft aluminum casting. It may be roughly stated that, according to actual practice, 50 pounds air pressure will perform twice as much work as 20 pounds, or 65 pounds will accomplish twice as much as 30 pounds, and 72 pounds twice as much as a 40-pound pressure. The air pressures used for different materials are as follows, and while only approximate, they nevertheless represent fair average practice: Steel castings or forgings, 80 to 100 pounds; malleable iron, 70 to 85 pounds; cast iron, 60 to 70 pounds; and brass and aluminum, 35 to 50 pounds.

The volume of air flowing through a nozzle opening at a given pressure is governed by the size of the nozzle. If the nozzle wears, due to sand passing through it, the opening becomes greater, the volume of air flow increases, and the pressure drops. This, of course, is undesirable, as the amount of work turned out decreases with reduced pressure, and the volume of air to be handled by the compressor becomes greater. The design of a nozzle should, therefore, be such as to reduce as much as possible the wear due to the friction of the rapidly moving sand. For economy in cleaning, a constant air pressure should be maintained, the amount of pressure being selected to suit the material to be treated and the abrasive employed.

For some classes of work a small nozzle opening, that is, a fine strong jet, may be desirable; for other work a broader stream, covering a larger surface but working at a lower pressure may be best. The amount of energy expended in both cases may be the same. With a nozzle 3/16 inch in diameter, and a pressure of 80 pounds per cubic foot, 47.50 cubic feet of free air must be compressed, requiring 8.65 horsepower; while with a ⅜-inch nozzle and 30 pounds air pressure, 90 cubic feet of free air is compressed and 9.27 horsepower is required. These values are given in Table 1, in which the relation between air flow in cubic feet of free air per minute at varying pressures, and the horsepower required to produce them by single-stage compression, is given for nozzles ranging in diameter from ⅛ inch to ⅜ inch, inclusive.

TABLE 2. CYLINDER DISPLACEMENTS AND HORSEPOWER REQUIREMENTS OF AIR COMPRESSORS

Cylinder		Revolutions per Minute	Piston Displacement, Cu. Ft per Min.	Horsepower Requirements					
				Pressure (Cu. Ft. per Minute)					
Diameter, Inches	Stroke, Inches			50	60	70	80	90	100
6	6	300	57	7	7.5	8.5	9.0	9.5	10
8	8	260	118	14	15.5	16.8	18.0	19.0	20
10	10	235	210	24	27.0	29.0	31.0	33.0	35
12	12	220	340	45	50.0	54.0	58.0	62.0	65

Machinery

TABLE 1. FLOW OF FREE AIR FOR DIFFERENT SIZES OF NOZZLES

Diameter of Nozzle, Inches	Pressure (Cubic Feet per Minute) and Corresponding Horsepower Required							
	20 Pounds	H. P.	30 Pounds	H. P.	40 Pounds	H. P.	50 Pounds	H. P.
⅛	7.70	0.63	10.00	1.03	12.30	1.50	14.50	1.99
3/16	17.10	1.40	22.50	2.32	27.50	3.26	32.80	4.49
¼	30.80	2.53	40.00	4.12	49.10	5.99	58.20	7.97
5/16	48.17	3.95	62.89	6.48	76.60	9.36	90.70	12.43
⅜	69.00	5.66	90.00	9.27	110.00	13.42	130.00	17.81
Diameter of Nozzle, Inches	**60 Pounds**	**H. P.**	**70 Pounds**	**H. P.**	**80 Pounds**	**H. P.**	**100 Pounds**	**H. P.**
⅛	16.80	2.57	19.00	3.19	21.20	3.86	25.73	5.33
3/16	37.50	5.74	43.00	7.22	47.50	8.65	57.88	11.98
¼	67.00	10.25	76.00	12.77	85.00	15.47	103.00	21.32
5/16	105.00	16.07	119.00	20.00	133.00	24.10	161.00	33.82
⅜	151.00	23.10	171.00	28.73	191.00	34.76	232.00	47.90

Machinery

Compressed air is not as inexpensive as it is sometimes erroneously thought to be, principally on account of the air itself being cheap. All air leakages should, therefore, be carefully guarded against, and the pipe connections maintained in first-class condition.

Moisture in Air

Due to condensation or weather conditions, moisture may get into the air. This is troublesome because moisture in compressed air prevents an even flow of the abrasive and causes the sand to form lumps, so that the wet, heavy material adheres to all surfaces with which it comes in contact and clogs up all passages. Moisture is also detrimental to pneumatic tools which are operated from the compressed air system. Therefore, in cases where there is moisture in the air, it is well to make provision for the elimination of the moisture by installing a moisture separator or a suitable heater.

Air Compressors for Sand-blasting

In selecting the proper size of air compressor, several points should be kept in mind. There is a difference between the volume of air actually delivered and the theoretical volume based on piston displacement. The air actually delivered in single-stage compression varies between 50 and 75 per cent of the calculated piston displacement. Typical cylinder dimensions together with the displacement and the horsepower required to develop various amounts of air pressure are given in Table 2.

A given energy horsepower is required to compress 1 cubic foot of free air to a given pressure. The speed of the compressor, therefore, not only governs the volume of air compressed but also the power required to compress it. It is possible, then, to run a compressor at lower speed, with correspondingly reduced horsepower, as long as a small amount of air is required, and to speed up the compressor later to full rated output when additional air is required. In any case, it is well to select a compressor large enough to take care of possible leaks and the wear of nozzles, and to keep in mind that almost invariably other applications are found for compressed air around the plant as soon as it is available for use, such as for operating air hammers, air hoists, chucks, sand rams, molding machines, etc.

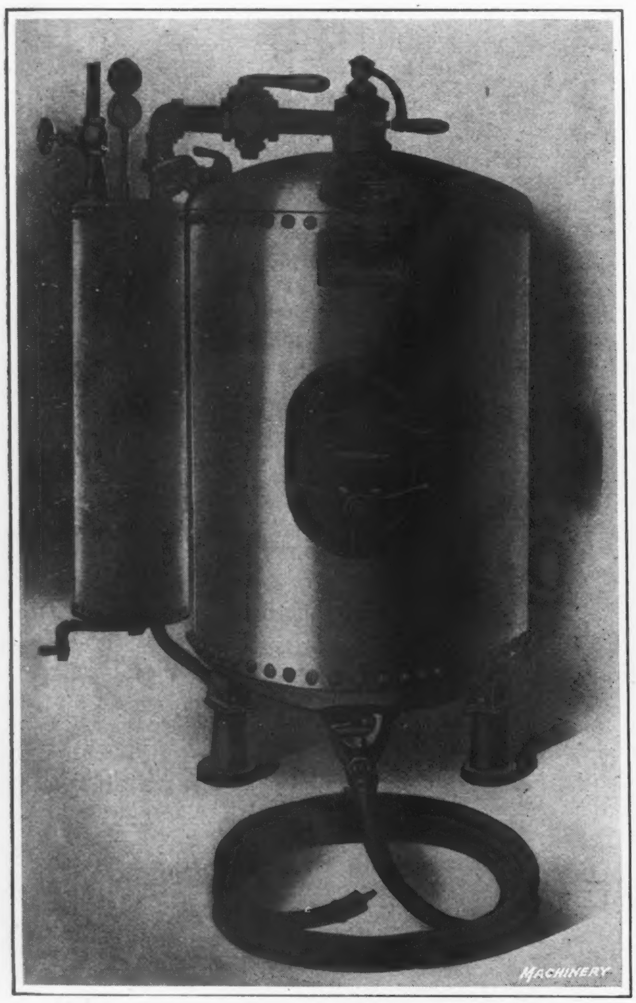


Fig. 4. Hose Sand-blasting Machine

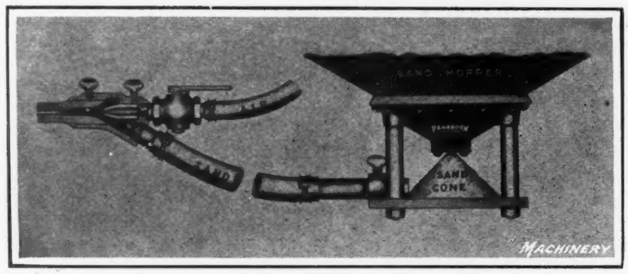


Fig. 5. Sand-blast "Gun" and Nozzle

Every compressor should be equipped with a governor (also called unloader or regulator), the function of which is to shut off the air intake automatically when the receiver is filled, allowing the compressor to run light, and thereby saving power until the pressure drops to a predetermined point. An air receiver should always be installed and should be located as near as convenient to the compressor. This receiver acts like the flywheel on an engine, preventing fluctuation in pressure due to the change in load caused by intermittent use of compressed air for various applications. Single-stage compressors are usually employed in the smaller plants requiring not over 200 or 300 cubic feet of air, but for greater volume a multi-stage compressor will be found to be more economical.

Different Kinds of Abrasive Materials

Sand is the most commonly used abrasive on account of its relatively low price. Ordinary lake or river sand is inferior to sea sand and silica sand, as the two latter possess greater hardness and are therefore more lasting. River sand results in more or less dust, and it disintegrates rapidly. Abrasives such as steel grit and shot are used to a certain extent, and the use of these more expensive abrasives is warranted under certain conditions. For classes of work such as electroplating or galvanizing, the metallic dust adhering to the work would make its use prohibitive, because it prevents perfect galvanizing, although no difficulty is experienced in this respect with sand.

There is no one abrasive that is best adapted to all classes of work. A selection must be made with due regard to reclaiming means, to greatest economy in operation and to maximum production. By making tests with various materials, and keeping accurate records of quality of work, output, life of the abrasive, etc., the one best suited for the individual application is readily determined. Such tests have shown metal abrasives to have about sixty times the life of sand. This apparently large percentage may, however, be offset to a great extent by losses of abrasive in operation or in handling. In good steel foundry practice these losses may be kept as low as 10 per cent, while the average loss due to disintegration, for different grades of sand, amounts to about 20 per cent per month. The reduction in cleaning time resulting from using metal abrasives instead of sand varies, of course, but a gain of about 15 to 20 per cent in time appears to be in line with actual practical experience. Metal abrasives do not require large sand-storage bins and have the added advantage of producing less dust, thereby improving the general working conditions.

All abrasives should be screened each time before using, to remove particles large enough to clog the nozzle, and also to eliminate fine particles which only produce dust and have no abrasive quality, but which consume some of the pressure. Screen separators, frequently operated by compressed air, may be used for this purpose.

Sand-blasting Machines

The hose sand-blasting apparatus already referred to, and shown in Fig. 4, is one of the earliest applications of the sand-blasting idea, and is at the present time very extensively used. It is an inexpensive machine, particularly adapted for doing miscellaneous work and for cleaning large surfaces, rather than for use in the quantity manufacture of medium-sized articles. The hose machine (except where a portable outfit is used for outdoor work, such as cleaning bridges or stone-work) demands some kind of enclosure, with ventilation to carry off the dust. The size and volume of the work determine the type of the enclosure. A room made of rough lumber with a wall fan discharging in the atmosphere or into a separate dust chamber is the simplest form. Such an arrangement is shown in Fig. 1, this being the enclosure for the sand-blasting equipment provided at the plant of the Concord Foundry Co., Elkhart, Ind.

Steel rooms are, of course, preferable where manufacturing environment justifies such protection. The hose machine may be set up either inside or outside the room. The rooms frequently are provided with grated floors through which the sand falls into a sand-bin or into a conveyor; or the sand-blasting machine may be placed directly under the room as shown diagrammatically in Fig. 3. The articles to be cleaned may be placed on a rotary table, one-half of which is being loaded and unloaded outside the enclosure.

This construction leads directly to the sand-blast cabinet design illustrated in Fig. 2 with the so-called "hygienic" or "humane" table on which the operator stands on the outside, manipulating the hose through a curtain and observing the work through windows. Suitable lamps with reflectors are provided. Instead of manipulating the hose, the sand-blast cabinet can be arranged with one or more sand-blast nozzles inside the cabinet, so that the operator can manipulate the work-piece by reaching into the cabinet and holding the work. Hands and arms are protected by gloves and suitable sleeves, and an observation window and lamps are provided to aid the operator. This type of machine is well adapted for sheet-metal goods, carburetors, milling cutters, etc., because each piece is handled individually, so that the danger of breakage or denting is obviated. The blast may also be directed upon those points where it is most needed.

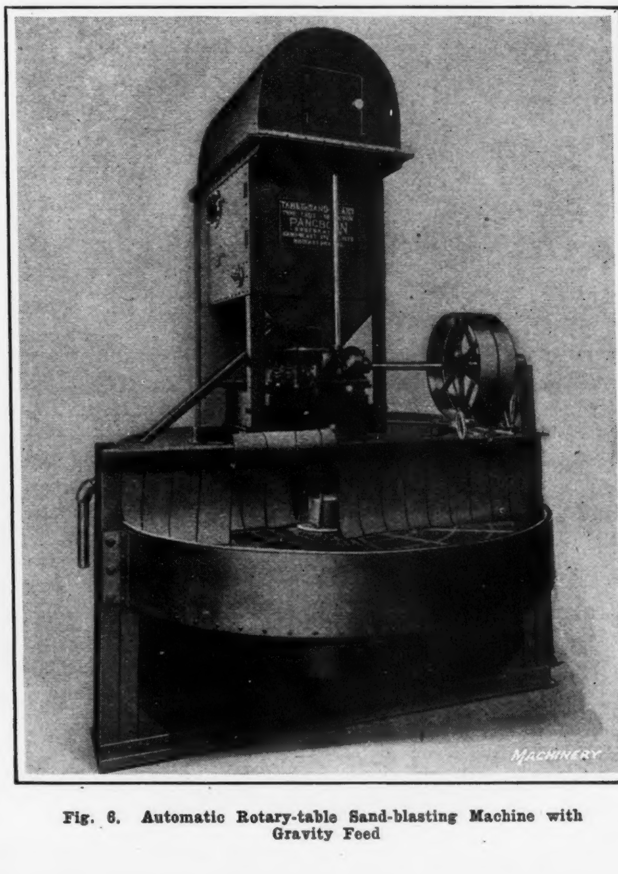


Fig. 6. Automatic Rotary-table Sand-blasting Machine with Gravity Feed

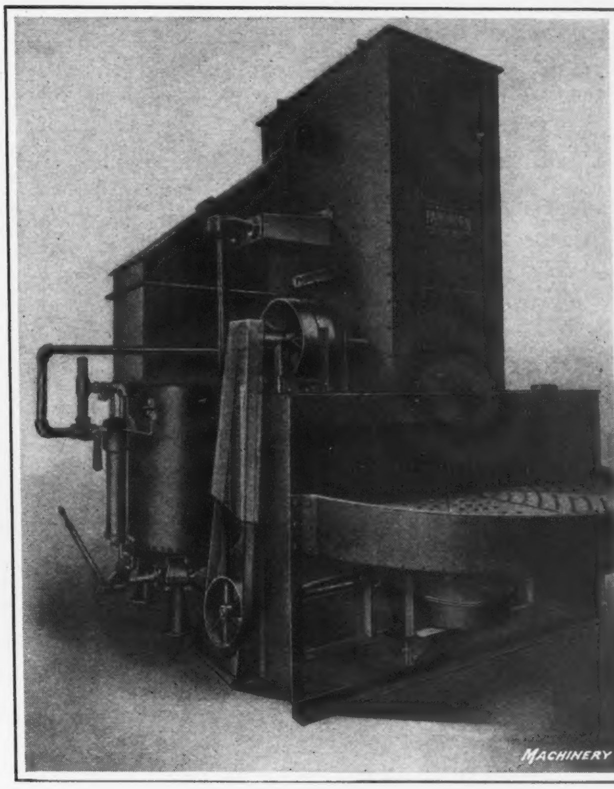


Fig. 7. Automatic Rotary-table Sand-blasting Machine with Direct-pressure Blast

This leads to the automatic rotary table in which the work is placed on a slowly revolving table, and upon entering the cabinet is exposed to jets of air and sand from one or more nozzles. To cover all sides of the work and all parts of the table-half, these sand-blast guns are arranged in various ways. The stream may be directed from different sides, or the nozzle holder may be designed to oscillate the nozzle automatically or to cause it to travel over the table in a circular motion or in a straight line. Figs. 6, 7 and 8 illustrate three designs of the automatic rotary-table sand-blast as built by the Pangborn Corporation; the one shown in Fig. 6 has a gravity-feed action; the one in Fig. 7, a direct-pressure and hose type blast; and the one in Fig. 8, a suction feed with swinging nozzle. Machines of the rotary-table type are well adapted for sand-blasting in the regular manufacture of smaller parts in large volume, and for fragile articles not suited for cleaning in a tumbling barrel.

Screw machine parts, hardened steel parts, pulleys, gears, and small automobile parts are frequently treated in sand-blast tumbling barrels of the type illustrated in Fig. 11. These barrels may be of the gravity type, the pressure type, or the suction type, the one illustrated being equipped with gravity feed. These tumbling barrels consist of a dustproof steel casing in which a steel drum *A* slowly revolves. Jets of sand enter the drum from the mixing chamber *B* after being admitted from the sand-box *C* through gate *D*. These jets effectively reach all sides of the articles contained within the revolving barrel. The air valve through which the compressed air is admitted to the mixing chamber is shown at *E*. The pressure type barrel differs from the gravity feed barrel particularly in that the sand under air pressure is contained in a steel tank beneath the machine. In the suction type tumbling barrel, the sand is delivered from a hopper above the machine and is caught at the nozzles by the air jet which forms the blast, being drawn in by the suction so created.

Exhausts and Dust Arresters

Sand-blast rooms should be well ventilated in all cases, by installing an exhaust fan, the size of which depends on the size and kind of work. It will be seen that the room shown in Fig. 1 has such a means of ventilating. The air in the room should be changed from four to ten times every

minute. Sand-blasting cabinets and rotary tables should always be equipped with piping connected to an exhaust fan in order to provide sanitary working conditions. Rooms, tables, and barrels may be installed in combination and ventilated by a single exhauster.

In isolated plants, or under any unusual condition it may be permissible to exhaust the dust-laden air directly into the atmosphere, but ordinarily some method of partially or completely gathering and settling the dust should be provided.

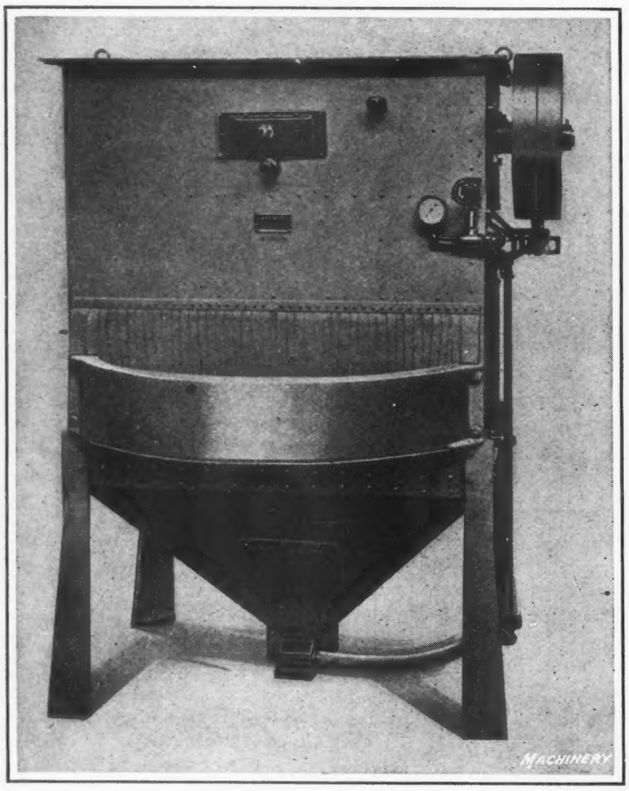


Fig. 8. Automatic Rotary-table Sand-blasting Machine with Suction Feed

The simplest method is a settling box or chamber into which the heavier particles fall by gravity, so that the particles light enough to be carried by the air are discharged into the open atmosphere by this simple method. About 95 per cent of the dust may be collected by an arrester, by means of which solids are caught by the centrifugal action of the device. The small percentage of fine dust which is not thus gathered by the arrester is carried out by the air current through a smokestack.

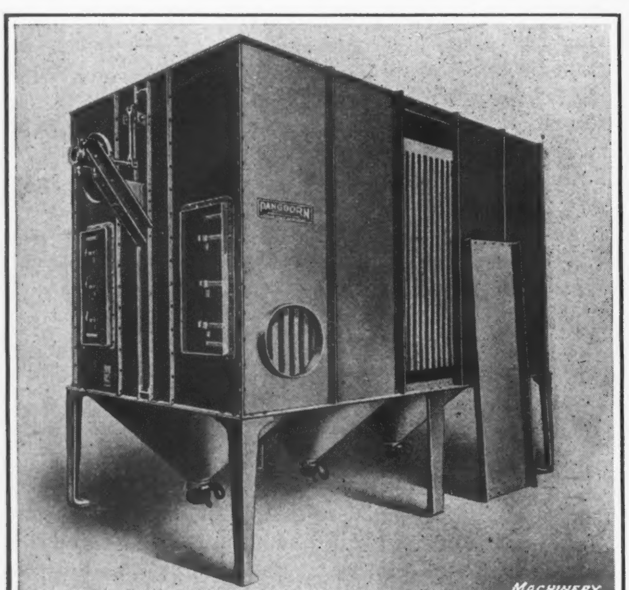


Fig. 9. Cloth Screen Dust Arrester

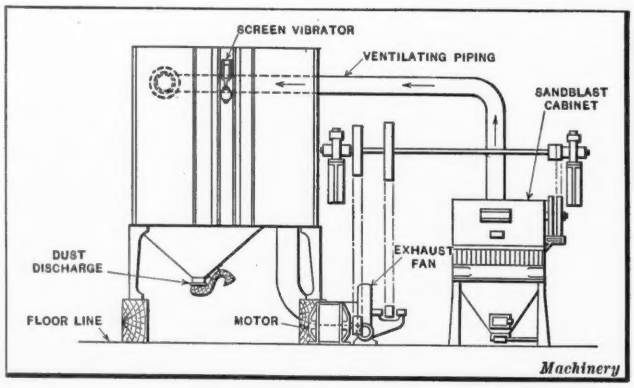


Fig. 10. Diagrammatic View of the Cloth Screen Dust Arrester

For plants in cities or, in fact, in all modern plants, more complete confining of the dust is necessary. This is accomplished by a cloth-screen type of dust arrester, Fig. 9, in which the dust-laden air is drawn into the sheet-steel cabinet by the exhaust fan, through a series of finely woven cloth screens, reinforced with a backing of copper wire. These screens are fitted tightly into the compartment so that all the dust is retained within the arrester. The dust is daily shaken off the screen by a rapping device, operated either by an electric motor or by air, and is then deposited in a

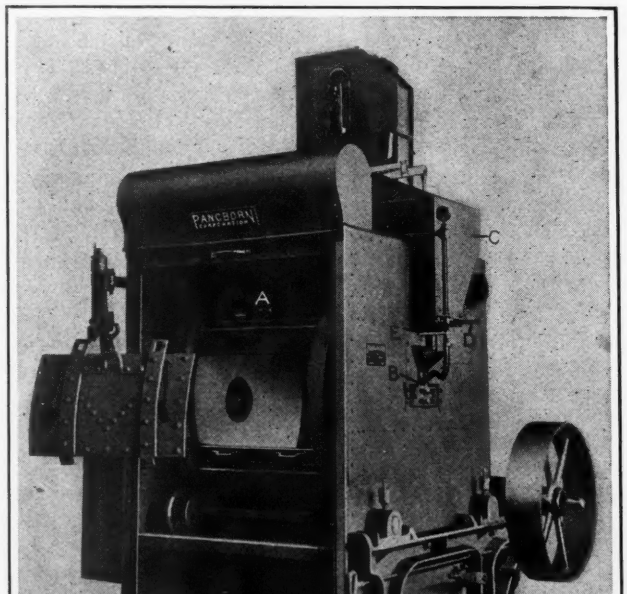


Fig. 11. Sand-blast Tumbling Barrel equipped with Gravity Feed

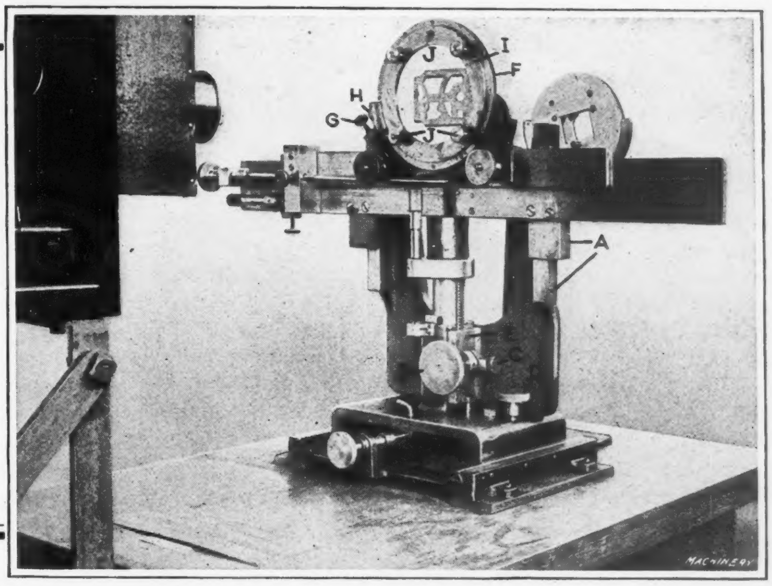
hopper provided with discharge spouts. The typical installation here shown consists of a sand-blast cabinet with exhauster, dust arrester and rapping device. Fig. 10 illustrates diagrammatically the construction of a cloth-screen dust arrester.

* * *

Although Sheffield has long been an important center for the manufacture of cutlery, England has been in recent years one of the best customers for American cutlery of all kinds. According to statistics supplied by Consul Washington, the imports of American cutlery into Liverpool amounted to $342,000 during the year 1918, and $473,000 during 1919, or about 30 per cent of all the cutlery imported into England. The total English annual purchase of American cutlery during 1919 was valued at $1,258,000.

Increasing the Scope of Projection Apparatus

By L. E. KING*



IMPROVEMENTS added to the gage-holder of the projection apparatus manufactured by the United States Bureau of Standards have made possible the employment of this device for accurately measuring distances on comparatively thin flat work such as templets, and punched parts for watches, clocks, typewriters, adding machines, etc. Small turned parts for the products mentioned can also be measured. In addition to the modifications made on the machine, a chart has been developed to facilitate measuring the distance between the center of a hole or arc, and the center of another hole or arc, or an edge of the work.

Improvements on Projection Apparatus

The heading illustration shows the manner in which the gage-holder was improved to accommodate work of the nature mentioned. The guides *A* are provided to prevent the swinging of the work about the vertical adjusting post when making a vertical adjustment of the work. This tendency formerly prevented the taking of satisfactory coordinate measurements. A device has also been added to permit very accurate vertical adjustments of the work to be made quickly. Rough vertical adjustments are made in the usual manner by turning handwheel *B* and then clamping it by means of screw *C*. Final adjustments are made by revolving handwheel *D* which actuates a lever underneath the base of the gage-holder. This lever slowly raises or lowers (the movement depending upon the direction in which the handwheel is rotated) part *E* on which are mounted handwheel *B* and the clamping screw *C*. The raising of the work by this arrangement is positive, but the lowering is dependent upon the weight of the gage-holder parts that are being lowered. However, the functioning of this adjusting device has been found satisfactory.

Attachment *F* is provided for conveniently holding flat work so that it can be adjusted to various positions as desired. A slow adjusting motion is provided by means of the tangent screw *G* and the clamping screw *H*. The work is mounted on the fixture by means of the clamping ring *I* and four thumb-screws *J*. For small work which must be held at or near the center of fixture *F*, an auxiliary clamping device is employed. This device consists of two thin metal strips of different lengths which are held together and adjusted by means of screws. The ends of the long strip are clamped under ring *I* and the work is held between this strip and the shorter one.

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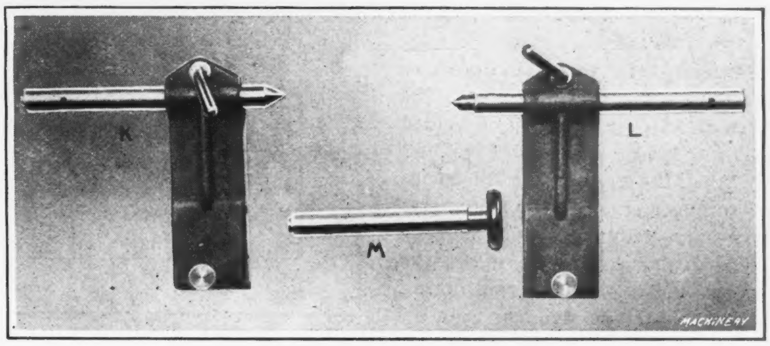


Fig. 1. Centers for mounting Round Work on Gage-holder

Centers for Supporting Work

Various styles of centers for holding turned work and other round parts on the apparatus for measuring when fixture *F* is not being used are illustrated in Fig. 1. The centers *K* and *L* are each provided with a male and a female center. On center *K* these are solid, but on center *L* they are of the spring type. The female centers are made removable so that centers of various sizes and different included angles can be substituted as required. A hollow center with a draw-in spindle and chuck is shown at *M*. This hollow center and the spindle are made to suit small standard split chucks for wire and drills. These centers are especially useful for holding small round parts when it is desired to have one end exposed.

Chart for Measuring to Centers of Holes and Arcs

The chart illustrated in Fig. 2 consists of a piece of heavy paper ruled with two sets of parallel lines at right angles to each other, and a series of concentric circles. This chart is securely and smoothly fastened to the top of the table on which the shadow projections of the work obtained by means of the apparatus are thrown. The chart should be so placed on the table that one set of the lines will be parallel to the direction of the travel of the shadow when making horizontal adjustments, and the other set will be parallel to the direction of the travel of the shadow when making vertical adjustments, when these directions are at right angles to each other. It is preferable to draw the sets of parallel lines to represent decimals of an inch. In the case in which the chart illustrated was used, the apparatus was set for a magnification of 75, and as the large divisions on the chart are laid out to 0.75 inch, they, therefore, represent 0.01 inch on the work. It will be noted that the large divisions on the chart are subdivided into five parts; each subdivision, therefore, represents 0.002 inch on the shadow, and one-half of a subdivision, 0.001 inch. The divisions described serve as a rapid check against errors for all measurements lying within the available field. They can also be used as a scale when the highest

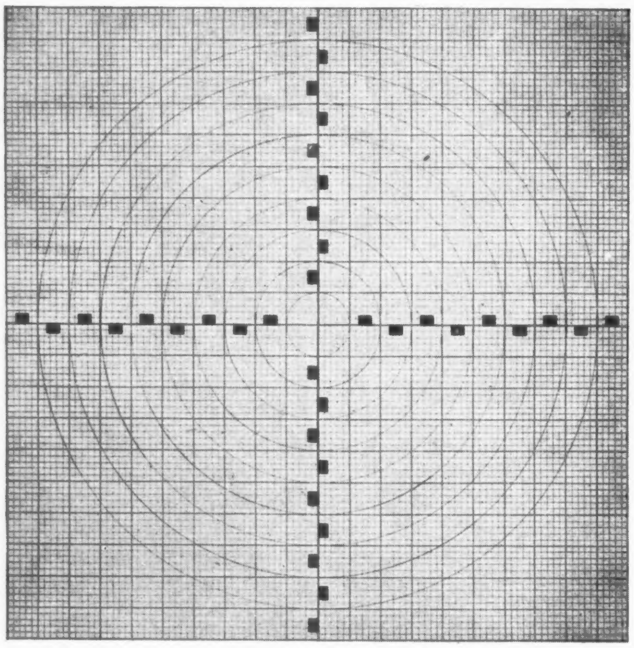


Fig. 2. Chart on which a Shadow of the Work is thrown for Measurement

accuracy obtainable is not required; otherwise it is best to rely on a similarly graduated scale having the main divisions numbered, or on the gage-holder micrometers.

The circles on the chart are useful in taking measurements from centers of holes or arcs to the centers of other holes or arcs, or to edges of the work, as the case may be. In operation, the center of the hole or arc shadow is made to coincide with the center of the chart by matching the edge of the shadow with the nearest circle. This is accomplished by the aid of the horizontal and vertical adjustments provided on the gage-holder. The difference between the corresponding micrometer readings for two such settings on a given piece of work will give the measurement desired. It is to be understood, however, that the circles are limited in their use to holes or arcs with radii, the shadows of which are not greater than the radius of the field available. In the case illustrated, the available field is equal to the size of the chart, the radius of which is ten large divisions which represent 0.1 inch on the shadow of the work.

The use of these circles for holes and arcs has been found to give more accurate results and to be a much more rapid procedure than the practice of working to the edges of holes or arcs. It will be noticed that the center lines of the chart are marked with small black rectangles so as to render them readily distinguishable. The lines of the main divisions are black while the subdivision lines and the concentric circles are red, these colors having been found to be the most suitable for observation in the semi-darkness in which the apparatus is operated.

* * *

COMPARISON OF SCREWED AND WELDED PIPE CONNECTIONS

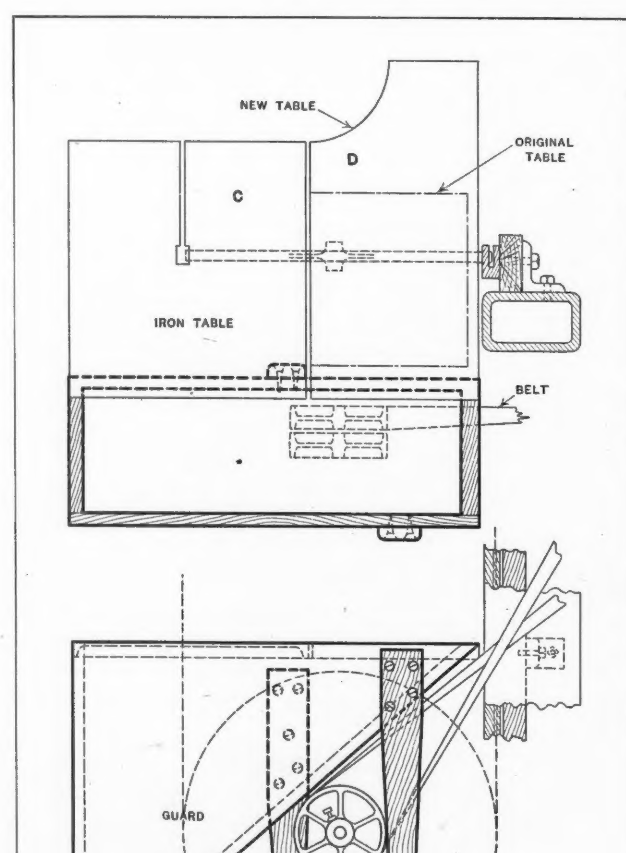
Comparative tests made by the University of Kansas of screwed and oxy-acetylene welded pipe connections are of interest in view of the fact that it is occasionally thought that piping should only be welded under unusual conditions and that the cost is greater than screwed connections. The results of these tests are given as follows: The cost of welded pipe connections is less than the cost of screwed connections; the larger the size of pipe, the greater the difference in cost. The time required to make screwed connections is about the same as that necessary to make welded connections. The strength of a welded pipe connection is practically the same as that of an unwelded pipe; by reinforcing or building up, the weld is said to be even stronger than an unwelded pipe. The elasticity of a pipe is not much affected by welding.

COMBINATION BELT GUARD, SCRAP BOX AND LUMBER REST FOR A BAND SAW

By M. E. DUGGAN

A combination belt guard, scrap box, and lumber rest for a band saw is shown by the heavy lines in the accompanying illustration. As the name implies, this device serves the purpose of a guard for the driving belt, a box for scrap lumber, and a support for long stock. The illustration also shows how an improvement over the original table shown by the dot-and-dash lines, was made by substituting a new table of larger size. This table was made flush with the top face of the iron table, and it proved to be of great advantage over the smaller table, especially when sawing large pieces. The additional table surface also forms a convenient place on which to put stock in cases where a number of pieces are to be sawed.

As shown in the lower view of the illustration, one side of the guard extends to the floor, while the opposite side, supported by two legs *A* and *B*, is made at an angle in order to clear the driving belt. The top edge of the guard next to the table is cut down to fit under the tables *C* and *D*; this prevents scrap from dropping on either the belt or the pulleys. The outer edge is made flush with the top of the table, and acts as a support when splitting long stock. When crosscutting long stock, the guard or scrap box is moved to a place on the floor where it will support the end of the board or stock to the best advantage. This feature makes the guard especially useful when a number of pieces are to be cut from the end of a very long board. It will be apparent that this guard can be quickly removed and replaced, thus making it convenient for the oiler to reach the mechanism.



Combination Belt Guard, Scrap Box, and Lumber Rest for a Band Saw

The German Machine Tool Industry

From MACHINERY'S Special Correspondent

Berlin, December 9

THE position of the machine tool industry in Germany is wholly unsatisfactory. Reports from machine tool shops employing nearly 14,000 workmen indicate that the degree of employment in about 10 per cent of these plants is good, with sufficient orders on hand; 79 per cent of these plants reported unsatisfactory conditions and lack of new orders. Many shops work only from thirty-two to forty hours per week, while a few work from forty-six to forty-eight hours per week. In the locomotive building industry, conditions are fairly satisfactory, and there is no serious unemployment; in the shipbuilding industry, the conditions of employment are also good, only a small percentage of the shipbuilding plants reporting an unsatisfactory condition.

The automobile industry suffers from a lack of new orders and from cancellations of old ones. The automobile plants are now working on stock, and different shops report weekly working hours from twenty-four all the way up to forty-eight. The same condition applies to the bicycle industry, where only a few shops report that they have a sufficient amount of work on hand to keep their shops going in a normal manner. The instrument makers report an unsatisfactory situation.

Scarcity and High Price of Raw Materials

During the past year various raw materials rose to such a price level that it was impossible for prices of finished products to keep pace with the increased prices of raw products. There has been a great deal of profiteering in the sale of iron and steel. German blast furnaces and steel mills charged home consumers more than they did foreign buyers, and the prices in the German home market are now higher than those in the world's markets. At the present time a Wotan shaper, having an 18-inch travel of the ram, is quoted at 33,000 marks, and a Samson shaper, with 23 inches travel of the ram, at 40,000 marks. Cast iron, in 1914, cost 0.32 mark per pound; today it is about 2.75 marks per pound.

Many of the machine-building plants employing thousands of workmen were placed in a very difficult position because they took orders at prices which became entirely too low when the raw materials rose on an unprecedented scale. Again, as the raw materials that they had bought were higher than those in the world's markets, they did not find a ready sale for their machines. Now, many of these machine-building plants are being absorbed by the large concerns in the iron and steel industry that were partially responsible for their difficulties because of the excessive prices that they charged for raw materials. Many of the mining and iron and steel companies had property in Alsace-Lorraine and met with losses on account of the provisions of the peace treaty. Many of these concerns have received compensation from the German government, and the liquid assets thus obtained were used for absorbing the smaller machine-building plants.

General Economic Situation

The economic situation of the country is far from satisfactory. In 1920 the governmental expenses amounted to over 90,000,000,000 marks, while the receipts were only about 24,000,000,000 marks, leaving a deficit of approximately 66,000,000,000 marks. To cover this deficit paper money has been issued, which has depreciated the value of the mark.

The operation of the German state railways in 1920 resulted in a deficit of 20,000,000,000 marks. All the large state undertakings have also resulted in deficits. The big works at Spandau, which were changed from the manufacture of guns and ammunition to a peace-work basis, suffered in 1920 a loss of 150,000,000 marks.

The political situation seems to be somewhat improved. No trouble is expected from the workers except possible demonstrations on account of the scarcity of food. Reports from the industrial centers show a greater willingness to work, although the efficiency remains low. The radicals, mostly younger men, have been shaken off by the older workers and the "Russian danger" also seems to be past. The socialistic party has been split into seven minor bodies.

Strikes and Lockouts

The statistics of strikes and lockouts which have recently been published for the years 1917, 1918, and 1919 show that in the latter year the number of strikes in Germany reached a figure hitherto unknown in the history of strikes in that country. The strikes took place mainly in the mining and metal-working industries, in the building trades, and on the transportation systems. The number of working days lost in 1918 was 4,900,000; while in 1919 this figure rose to 43,600,000. Strikes were more numerous in Berlin than anywhere else, and of the total number of days lost 41 per cent was lost in the city of Berlin in 1918, and over 50 per cent in 1919. The struggles between capital and labor have been most severe in Berlin, in Westphalia, and in the Rhineland. In 1918 there was not a single case of lockout, but in 1919, out of the total working days lost, 1.7 per cent was due to lockouts, while 98.3 per cent was due to strikes. Of the strikes during 1919, 14 per cent resulted in victory for the workmen, 68 per cent were partly successful, and 18 per cent resulted in failures. Altogether over 20 per cent of the workers of Germany were on strike at one time or another during the year.

The official census distinguishes between political strikes and economic strikes. In 1919 the political strikes accounted for 12,900,000 lost working days as compared with 32,500,000 lost working days due to economic strikes. Strikes on the part of office workers for higher salaries resulted in nearly 2,000,000 lost working days.

German Foreign Trade

The German foreign trade for the first six months of 1920 assumed a considerable volume. Exports from Germany to the United Kingdom in the period mentioned were valued at nearly £12,000,000; to France at nearly £33,000,000; and to Belgium at over £13,000,000; while the exports to the United States were less than £7,500,000. The imports from the United Kingdom amounted to nearly £11,000,000; from France, over £16,000,000; from Belgium, nearly £23,000,000; and from the United States nearly £25,000,000.

* * *

A new customs tariff to prevent dumping and to protect new Japanese industries went into effect August 1, 1920, in Japan. Several changes were made in the tariffs relating to metal- and wood-working machinery, different tariff duties being imposed upon machinery according to its weight, the number of classifications being ten. Complete information as to the provisions of this new customs tariff inasfar as it affects metal-working machinery may be obtained from the foreign tariff division of the Bureau of Foreign and Domestic Commerce, Washington, D. C.

Common Causes of Errors in Machine Design

Basic Causes of Errors—Authority Affecting Design—Completeness of Information Required
First of a Series of Articles

By R. H. McMINN

WHEN a machine is designed and built by a manufacturer to fit certain prescribed conditions of space and capacity, with perhaps a few special features, but operating on the same general principle as machines previously built by this manufacturer, one or more errors are sometimes made by the drafting-room and become evident during the manufacture, assembly, shipping or operation of the machine. The following examples are cited to illustrate the kind of errors that are often made under such conditions:

1. Several cored holes in one casting are wrongly located due to incorrect dimensions. These must be plugged and new holes drilled.

2. One casting is a little too large to be machined by the largest planer in the shop. This casting could have been modified in design so the planer could handle it, if the necessity had been discovered in time, but it now must be sent to a jobbing shop for planing.

3. One part will not go in place during assembly without machining off a portion of a rib on another part.

4. Some structural material, which is a part of the machine, has been shop-riveted in its entirety, but in being loaded it is found to be too large in one direction to allow for proper clearance in shipping. The drawings failed to show that certain joints should have been field-riveted. The rivets in these joints must be cut off and the joints reriveted in the field.

5. One of the doors in the purchaser's building, through which the machine parts must be taken to the place of erection, is too narrow to admit the largest casting due to a projecting arm on the side of the casting. There is no reason why this arm could not have been bolted on instead of cast on. A portion of the wall at the side of the door must be cut away to allow the casting to pass through. The purchaser's building drawing showing the width of this door had been given to the manufacturer.

6. The state factory inspector notes that certain gears, comprising a part of the special added features, are not properly guarded. The manufacturer of the machine has to provide guards. Means could have been devised to attach them much more easily if the matter of providing guards had been given attention at the time the machine was being designed.

7. After operating the machine for several weeks an air cylinder with a piston having a leather cup packing will scarcely perform its function because of leakage past the piston. Examination shows that the leather cup is damaged due to working in a temperature too high for leather. This cylinder is on the back of the machine and comes very near one of the walls of a furnace, the heat from which has affected the leather. The location of the new machine in reference to this furnace had been indicated on the building drawing submitted by the purchaser to the manufacturer, but its significance had not been sufficiently considered. The manufacturer must now provide a piston with metallic rings.

There was nothing particularly new about the machine taken as an example. Its design involved no untried or unknown principles. Yet probably some concerns never made a new machine under the conditions described without encountering at least one error and sometimes many errors traceable to the engineering department. In some cases these errors are trivial and in others they are serious.

However, the degree of accuracy attained in comparison to the chances of error involved may not be low. Let us consider some of the chances of error in merely writing a bill of material for a bolt used on a machine. An error may be made in the type of head, diameter, length under head, kind of thread, length of thread, locking means, kind of material, and quantity of bolts needed. In a complicated casting there may be dozens of simple geometrical forms combined, involving the selection of their shape to perform certain functions, determination of their location for certain purposes, and their size for strength, wear, clearance, and other reasons. In addition to the actual considerations of correct design of such a casting, which involve scores of chances of error, is the matter of correct dimensioning which offers several score more chances on one complicated casting only. Any well filled 24- by 36-inch detail sheet offers from several hundred to a thousand chances for engineering department errors. A machine, such as a traveling crane, may have from ten to twenty or more such sheets. The first step in eliminating errors must lie, therefore, in a full recognition of the liability for their occurrence.

A succession of even comparatively minor errors discovered during the process of

The author of the series of articles on "Common Causes of Errors in Machine Design" has made a careful study of drafting-room errors, their underlying causes, and the reasons why designs are not always what they should be. Draftsmen as well as experienced designers will benefit by studying these fundamental causes, which have been analyzed and recorded after a long series of observations backed up by years of diversified experience. While all designers realize the importance of preventing errors as far as possible, it is not generally appreciated that these errors can be reduced to a minimum by making a study of the fundamental reasons for them and by systematically applying such methods as are likely to prevent the occurrence of common errors.

building a machine tends to disrupt the smooth running of both engineering department and shop. It is only by striving for the highest possible standards of accuracy that an engineering department can hope to avoid an error at some time which may cause loss of life or property. For an individual or a concern which is striving to eliminate errors, it is a good plan to attempt to find the basic cause underlying each error discovered, to classify all causes of errors found, to record the number of errors attributable to each cause, and to attempt to devise methods to reduce the number of future errors in each class. It is the intention of the author to present information that will enable such a procedure to be followed. The first step is to determine the basic causes of errors.

Basic Causes of Errors

A large number of errors that are frequently made are traceable to a few basic causes. A survey of some important facts that affect design with some suggested methods of procedure for draftsmen may help to guard against errors due to these causes. Following are some of the common causes of errors made in designing a machine or structure: Ignorance of the necessity for considering some factor that should partially determine design; changes in design half considered and incompletely made; too liberal use of memory; lack of concentration; reasoning too far from slight experience or knowledge; lack of systematic methods of applying full knowledge and experience.

A succession of even comparatively minor errors discovered during the process of building a machine tends to disrupt the smooth running of both engineering department and shop. Only by striving for the highest possible standards of accuracy can an engineering department hope to avoid serious errors. For an individual or a concern which is striving to eliminate errors, it is a good plan to attempt to find the basic cause underlying each error discovered, to classify all causes of errors found, to record the number of errors attributable to each cause, and to attempt to devise methods to reduce the number of errors in each class.

The following list gives some of the important factors which should be considered in the design of a machine. It is here assumed that it is an error to neglect not only those aspects of design that affect operating results but also commercial considerations. Each of these factors and its relation to the design of machinery in general, will be considered in this and subsequent articles in this series, the various subjects being dealt with according to the successive order in the following list. The present article deals with the first two points.

1. Authority affecting design of a machine
2. Completeness and accuracy of information
3. Physical and chemical laws affecting design
4. Functioning of parts
5. Speed and timing of relative motions of parts
6. Positiveness of action
7. Clearance between parts
8. Suitability of materials
9. Strength of parts
10. Durability
11. Adjustment
12. Simplicity
13. Accessibility of parts
14. Lost motion
15. Friction
16. Lubrication
17. Balancing parts
18. Manufacturing operations
19. Assembly
20. Erection
21. Disassembly
22. Transportation
23. Safety
24. Cost
25. Compactness
26. Appearance
27. Influence of working environment of a machine
28. Reaction of a machine on its environment
29. Correctness of drawings and bills of material

Authority Affecting Design of a Machine

One of the first things to be considered in designing a machine is any authority above the designer which places restrictions or imposes modifications on the design. There are a number of sources of authority which prevent a designer from using his own judgment about some features of design. The principal sources of such authority in this country are: (1) United States Government laws; (2) state laws; (3) municipal laws; (4) Fire Underwriters regulations; (5) purchaser's specifications; (6) special instructions of a superior; and (7) plant standards.

One authority which the National Government imposes upon the design of a machine is the Patent Laws. It is necessary for one to confine his designs to combinations that do not infringe on patents still in force. If a designer is working independently and is not thoroughly familiar himself with the state of the art in reference to the kind of machine he is designing, there is no way to tell whether the machine does infringe without a thorough search of patent records. An application for a patent will eliminate further chances of doubt regarding infringement, and an infringement search still others. In some cases the future alone will show whether a machine will be held to infringe a prior one, but the designer should at least make an earnest endeavor to avoid infringement. If he is working for a manufacturer, this responsibility rests partly upon the company. Up-to-date companies attempt to keep thoroughly posted on all patents affecting the line of manufacture in which they are engaged.

All boats of American registry must be approved by United States inspectors as to hull design, boilers, life-saving equipment, and other machinery affecting the safety of the ship and passengers. The design of railroad train brake-control apparatus, locomotives, car couplers, and some other car equipment is subject to the approval of the national government. It is probable that the design of airplanes and dirigibles will be brought under United States Government approval, since they will be engaged in interstate flying and their use is hazardous.

The various states exercise authority over some of the hazardous industries within their boundaries, such as in the construction of mines and factories and the design of certain machines used therein. Some of the laws affecting mine construction and machinery cover means of exit, drainage, ventilation requirements, boilers and accessories, hoisting equipment, signal systems, fire-fighting apparatus, and maximum voltage allowed. Factory laws may cover ventilation, sanitary provisions, fire protection, fire escapes, elevators, emergency stopping of power-driven machinery and the safeguarding of certain machines by special guards or restrictions as to location. In some states the laws are more rigid and place restrictions upon a larger number of kinds of industries and machines than in others, so that one should become familiar with the laws which affect a certain industry or machine in this respect, in the particular state under consideration.

A restriction, in effect, is placed upon the design of all buildings within a state (except sometimes those built by an owner for his own use) by requiring that the plans be supervised by a licensed architect or structural engineer who has passed an examination as to his capability. A licensed structural engineer must supervise the plans for other structures such as grain elevators, docks, bridges, blast furnaces, gas producers, reservoirs and dams.

The larger municipalities have ordinances governing the design of buildings or other structures within their city limits. The design of a building must not only be approved, but in many cases certain types are confined to certain prescribed fire zones. Allowable unit stresses are definitely established and restrictions cover practically all elements entering into a building, including heating systems, plumbing, and electric wiring. Cities also have laws governing design

of boilers, elevators, tanks or piping under pressure, and all electric transmission systems outside of buildings. Since the laws of the various cities are not uniform, it is necessary to know the ordinances governing the design of any building or equipment of the classes mentioned, which is to be erected or used in a particular city. If any other kind of equipment or machine the use of which involves possible dangers to life or property is being built for use in a certain city, it is well to see if there are ordinances restricting its design.

Fire Underwriters' Regulations

The fire insurance companies have adopted as their regulations and requirements the recommendations of the National Fire Protection Association, whose membership is composed of representatives of fire insurance companies and various engineering societies in the United States. Any building, street-car, boat, or other structure carrying fire insurance should conform, in its design and in the design of any equipment used therein, to the regulations of the fire insurance companies in order to obtain insurance at the lowest possible rate. If these rules are ignored, a higher rate will be placed upon the structure than would otherwise be imposed, or if there is a radical departure from the rules, a continuation of insurance may be refused.

The National Board of Fire Underwriters has issued a large number of pamphlets containing regulations on the design and installation of equipment affecting fire hazards. The best known of these is probably the "National Electric Code," which relates to electric wiring and equipment. Other pamphlets contain regulations for standard mill type construction of buildings; skylights; protection of openings in walls and partitions against fire, including the design of shutters and doors and protection of openings for passage of driving belts or shafts; oxy-acetylene heating and welding apparatus; acetylene gas machines; kerosene oil pressure systems; gasoline lighting systems and equipment; fuel oil storage and burning equipment; containers for storing and handling of hazardous liquids; storage and handling of nitro-cellulose motion picture films; construction and installation of dip tanks containing inflammable liquids; stationary internal combustion engines and coal gas producers; and blower systems for heating and ventilating or for conveying stock or refuse material. Still others relate to the approved design of strictly fire protective equipment, such as vaults, gravity and pressure water tanks, standpipe and hose systems, gas shut-off valves, sprinkler equipment, alarm systems, fire pumps, hydrants, valves, and hose fittings. The National Board of Fire Underwriters states that any new materials or equipment affecting fire hazards or for fire protective uses should be submitted to the Underwriters Laboratories, located at Chicago, for examination and test before being introduced for use.

Purchaser's Specifications

When a purchaser orders a machine for a certain purpose, which is to have a specified output, he may radically affect the design of the machine the manufacturer would normally build for the output required, by demanding certain modifications in accordance with his own ideas or to suit certain special conditions. It is necessary to watch such instructions carefully. If they conflict with any higher authority or appear impracticable, the purchaser's consent must be obtained before deviating from them.

Sometimes a purchaser orders a machine which is to be a duplicate of one previously ordered. If the manufacturer has made improvements in the design of this machine since it was sold to the purchaser, the purchaser's consent should be obtained to embody the improvements in the new machine. If the improved machine is not identical in manner of operation with the old one, or if separate sets of emergency repairs would have to be carried in stock by the purchaser, he may prefer an exact duplicate of his first machine. This is especially true if the purchaser was entirely satisfied with the performance of the original machine.

Special Instructions and Plant Standards

The design of a machine must always be in accordance with any special instructions given by the designer's superiors. If these instructions are contrary to any of the authorities previously mentioned, this should be pointed out by the designer. If the carrying out of any of the instructions would conflict with recognized good practice or the designer's experience, it is his privilege and duty to make this known to his immediate superior. Not only must the definite instructions relating to any particular design be followed, but most plants have certain standard patterns, parts, and methods, which must be used, unless it is impossible to utilize them in a special design, or unless their use conflicts with a higher authority.

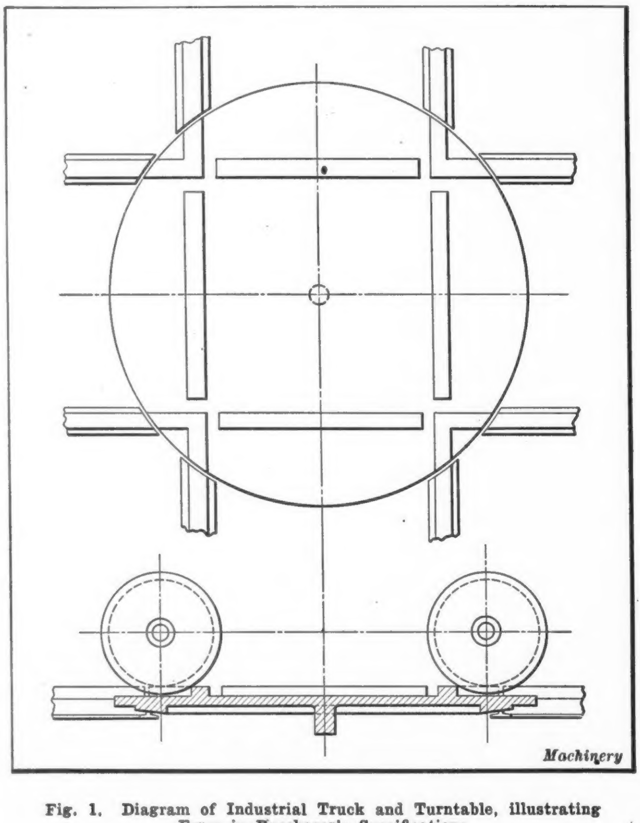


Fig. 1. Diagram of Industrial Truck and Turntable, illustrating Error in Purchaser's Specifications

Completeness and Accuracy of Information Required

An important part of engineering work consists in the gathering, interpreting, distributing and acting upon information relating to the job at hand. Designers and draftsmen must learn to act only upon the best obtainable evidence. The best evidence as to how a machine or part must be made is that shown by a specification, letter, or drawing submitted or approved by a purchaser as indicating his requirements. The best evidence of how a machine or part has been or will be made by a manufacturer is the drawing which has been or will be used to make it. This assumes that the shop is not permitted to deviate from drawings without the consent of the engineering department, and that when a change is decided upon that the necessary drawings are immediately corrected.

Correspondence from Purchaser

The design for a machine is often based upon the specifications or drawings submitted by a purchaser to a manufacturer, indicating special features or dimensions desired on a type of machine made by that manufacturer. From these the manufacturer may prepare more detailed specifications, and possibly a preliminary drawing, outlining what he expects to furnish if he receives the order. Frequently a voluminous correspondence is carried on after the placing of an order for a machine and even during the process of design.

Statements and dimensions given in some of these letters may annul or amend portions of the original specifications. Revised blueprints may also be sent in by the purchaser to supersede former blueprints submitted to the manufacturer. While a digest of the information definitely relating to design could be made from the correspondence as it comes in and be given to the man working on the design of the machine, this admits the possible error of failing to transmit to the designer some necessary information. The best plan is to have all correspondence relating to the order for a new machine bound together and submitted to the designer or draftsman who is to work up the drawings. It is important that all oral instructions given by the purchaser should be confirmed in writing.

When Purchaser's Specifications are not Complete

All correspondence must be carefully read by the designer, and notes made of information affecting the design of the machine. If there are any discrepancies in statements made or dimensions given, it is necessary to take up with the purchaser which ones shall be taken as correct. Failure of the purchaser to give information about some feature or dimension that usually is given by purchasers of that particular kind of machine does not justify the assumption that the point left open may be settled by the manufacturer. If a purchaser ordered a foundry cupola and failed to give the distance from the ground line to the bottom of the charging door, the manufacturer is not justified in locating the door at a distance above the ground which is average for the size cupola ordered. The question of this height is related to the particular foundry where the cupola is to be installed, and this distance must be specified by the purchaser.

When Purchaser's Specifications are Evidently Incorrect

If a designer should believe from all the information in his possession that the machine as definitely specified by the purchaser will not be suitable for the latter's requirements, he should call the attention of a superior to the apparent difficulty. Let us say that a number of small industrial trucks of a certain size, wheel-base, and track gage are ordered, together with some turntables of a certain diameter and the same track gage as the trucks, and that examination shows that the wheels will extend over the ends of the track on the turntable when the truck is centrally located, as shown in Fig. 1, and thereby interfere with the rotation of the turntable. Even though the order may not specifically state that they are to be used together, it is presumable that they are so intended, and the designer should call the circumstances to the attention of a superior so the purchaser can be notified of this possible discrepancy. It is probable that if the turntables are made as ordered and are intended to handle the trucks, the manufacturer will be censured for not noticing the difficulty, and will be asked to take back the turntables or the trucks (whichever will inconvenience the purchaser the least) even though they have been made specially to his order. It is not always good business policy to go into the legal phases of such requests, and therefore the designer should use all the information he possesses regarding the particular conditions that may influence acceptable designs, so as to determine whether a machine as ordered and specified will be satisfactory to the purchaser.

Reference to Previous Designs

If there are points in design that should be settled by the designer's superiors these should, in so far as possible, be decided upon before the drawings are started. Not only must up-to-date drawings be selected for reference, but any particular drawing, part, or dimension must be positively identified as being the one wanted before it is used. Probably more errors result from improper identification than from wrong reasoning. One may select the wrong drawing, if there are two machines alike save in size; the wrong part, if there are two parts on a machine somewhat similar in appearance; or the wrong dimension if there are two near each other that do not differ greatly. The exact dimension line and dimension that designates the distance between the holes, surfaces or parts under consideration must be positively identified. Looking up a dimension may be done almost automatically, and yet a rigid check should be kept on one's work by constant and critical attention to each step.

Checking Specifications

When the design of a machine is complete, the designer should again read in full all information submitted by the purchaser relating to the machine, in order to see if all requirements have been embodied in the drawings. It is possible that some of the statements made in the correspondence will have a clearer significance, since the designer will now be thoroughly familiar with the machine, and he will frequently discover by this second reading that some of the specifications have not yet been properly complied with, due to oversight or misinterpretation at the first reading.

It may happen that a letter or blueprint sent by the purchaser specifying certain changes may not reach the manufacturer. In such circumstances the failure to acknowledge it would, in most cases, cause the purchaser to ask for an acknowledgment, and thus its non-receipt would become evident. But, the purchaser might fail to notice that a letter or revised blueprint was unacknowledged; or one might be received by the manufacturer, which was acknowledged, but was not properly transmitted to the designer, and hence an important modification might be overlooked. In order to avoid errors due to such circumstances or possible misinterpretation of any data submitted by the purchaser, and in order that he may have the fullest possible understanding as to just what will be furnished, it is the best plan to submit to the purchaser a revised set of specifications in conformance with all the changes made in the correspondence, together with a set of blueprints showing the machine as it will actually be made. These specifications and blueprints, properly approved by the purchaser, form the best authority that can be obtained as to what will be acceptable in a machine that must be built specially.

Subsequent articles in this series will deal with further important factors in the design of a machine, among which are physical and chemical laws affecting design, functioning of parts, timing of relative motions, clearance between parts, suitability of material, strength of parts, durability, and many other points that must be carefully considered to avoid errors in the completed mechanism.

* * *

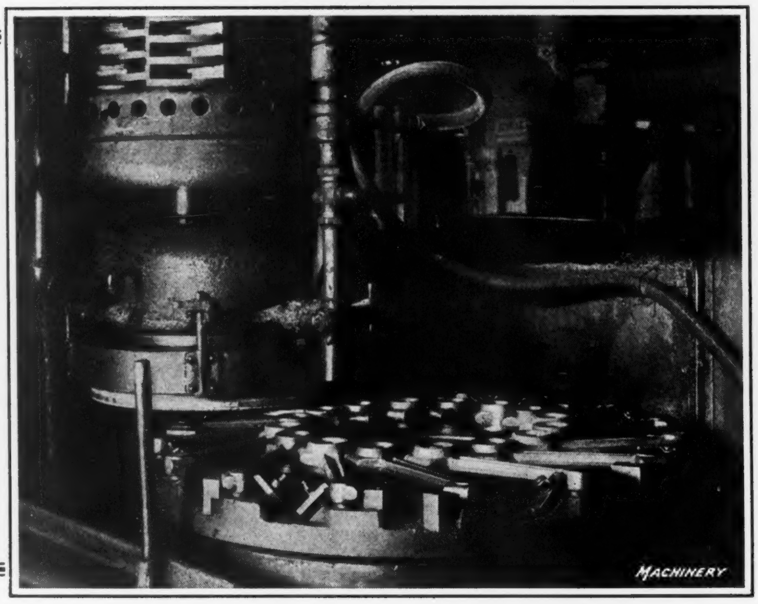
REMARKABLE SAFETY RECORD

A remarkable record for safety of machine shop operation has been made by the Geuder, Paeschke & Frey Co., Milwaukee, Wis., and in view of the efforts made everywhere to reduce accidents in the industries, some details relating to the accomplishment of this company will prove of interest. In the company's sheet-metal working plant, 50 punch presses were run 104 continuous days with no accidents, and 800 machines of various kinds were employed in the other departments of the company for 90 consecutive days with but two accidents. These results were accomplished by making the foreman the backbone of the safety organization, and in this way the company obtained not only safe production but maximum production at the same time. Every foreman accepted full responsibility for his department. One of the fundamental means for the reduction of accidents, the foremen say, was the careful instruction of new employes. Special attention was also given to providing proper mechanical safeguards wherever these could be advantageously applied. The management of the plant is convinced that it has demonstrated the possibility of running punch presses without accidents; that a factory endowed with the spirit of preventing accidents can do so; and that increased production and safety can go hand in hand.

Making Connecting-rods for Franklin Cars

Machines and Fixtures Used at the Plant of the H. H. Franklin Mfg. Co., Syracuse, New York, for Drilling, Boring, Milling, Grinding, Reaming, and Gaging Operations

By FRANKLIN D. JONES



THE connecting-rods used in motors of Franklin cars undergo an interesting series of operations requiring the use of special machines and fixtures designed to insure extreme accuracy of size and alignment. These connecting-rods, which are made of nickel steel drop-forgings, first pass through certain preliminary operations such as annealing, inspection, sand-blasting, straightening (if necessary), heat-treating, and Brinell testing for hardness. The rough drop-forgings are annealed in mica, a temperature varying from 1400 to 1500 degrees F. being maintained for at least two hours. The forgings are then placed between flat dies under a drop-hammer and straightened if necessary. A second heat-treatment, which occurs before the first machining operation, consists in heating to from 1475 to 1525 degrees F., quenching in oil, and then drawing at a temperature of from 900 to 950 degrees F.

Grinding Faces of Connecting-rod Ends or Hubs

The forgings, after this heat-treatment, are ready for the first machining operation, which consists of grinding the faces of the large and small ends first on one side and then on the other. This is done on a Blanchard grinder. The fixture used (see the heading illustration) holds sixteen forgings at a time. The large ends fit over plugs, which are attached to the fixture and have radial clamping pins that are forced outward by a conical headed screw in the center of the plug. On this fixture there are eight locating surfaces for rough forgings, which alternate with eight locating surfaces for forgings ground on one side. The latter surfaces are higher than those used for the rough forgings, in order to allow for the amount that is ground off one side. When the operation is first started, only eight forgings are placed on the fixture; after these have been ground on one side, they are turned over and transferred to the positions having the higher locating surfaces. The eight vacant places thus left on the fixture are filled with rough forgings, so that the fixture is fully loaded. From now on the faces of sixteen forgings are ground on one side simultaneously. With this arrangement eight forgings that have been ground on both sides are removed from the fixture after each grinding, and those which have only one side ground are turned over to the finishing positions of the fixture and are replaced with eight rough forgings. As these finishing positions are high enough to compensate for the amount ground from one side, all the rough surfaces that are in the upper or grinding position are practically in alignment. The grinding wheel is located vertically by means of stops, for grinding the sides of the large and small ends of the forgings which are not on the same level. The total amount ground from the forgings is approximately 1/16 inch, and the limit for width is 0.003 inch. The time allowed for this operation is two minutes for each forging.

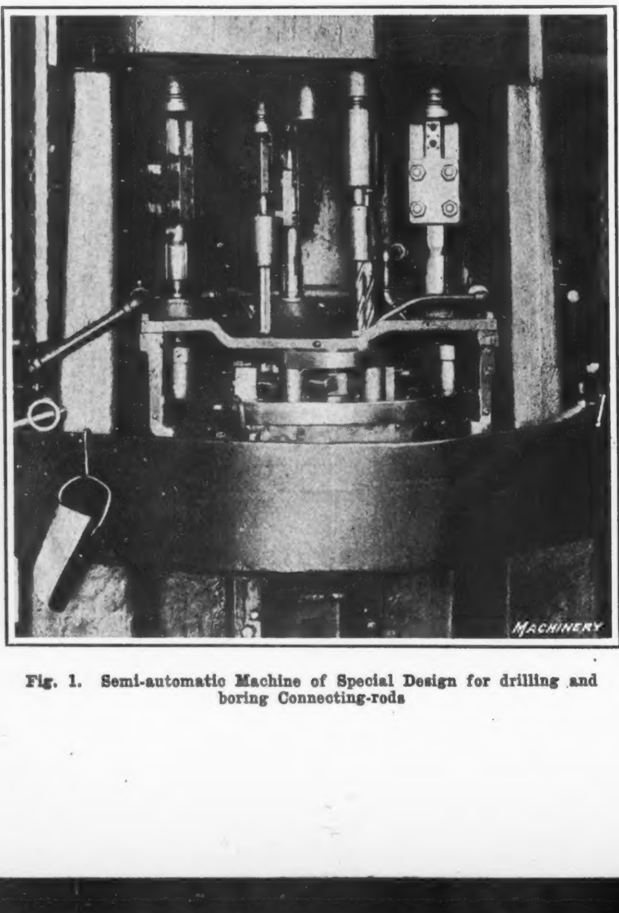


Fig. 1. Semi-automatic Machine of Special Design for drilling and boring Connecting-rods

Drilling, Boring, and Reaming Connecting-rod Forgings

The semi-automatic machine used for drilling, boring, and reaming the large and small ends of the connecting-rod forgings is illustrated in Fig. 1. The large end is finished in this machine to a diameter of 1⅞ inches, but the hole in the small end is left from 0.007 to 0.010 inch under size to allow for a final grinding operation. The special machine used is of the station type and has three working positions with a loading position in front. The large ends of the forgings are centrally located by cupped screw bushings, and the table feeds upward automatically, motion being derived from a cam at the lower end of the table slide. The indexing movement of the table is controlled by hand, the table being located in the different positions by a plunger operated by a small hand-lever.

The special fixture used for drilling the bolt holes in the small ends is shown in Fig. 2. This fixture, which is used in conjunction with a multiple-spindle drilling machine, holds sixteen connecting-rods, twelve being in the three drilling positions and four in the loading position. The machine is equipped with four tap drills for ⅜-inch bolts, and eight

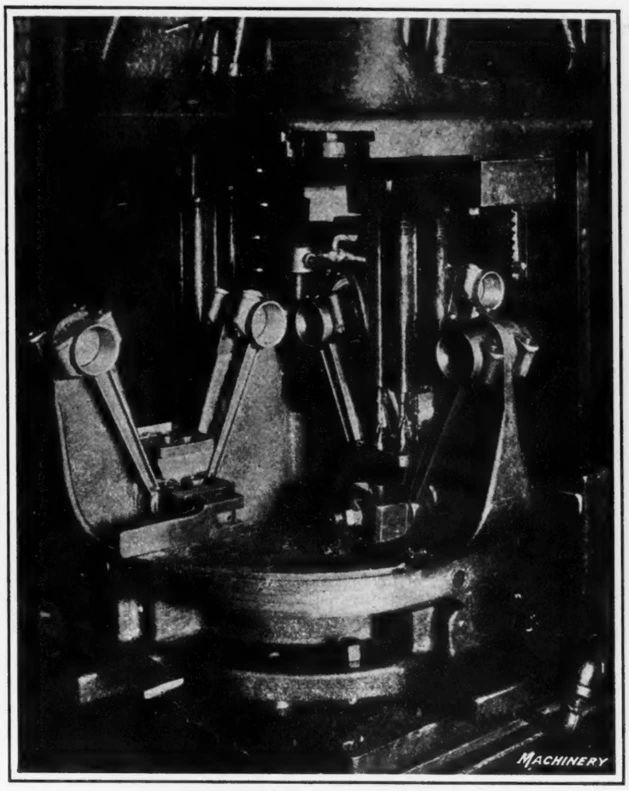


Fig. 2. Drilling Bolt Holes in Small Ends of Connecting-rods

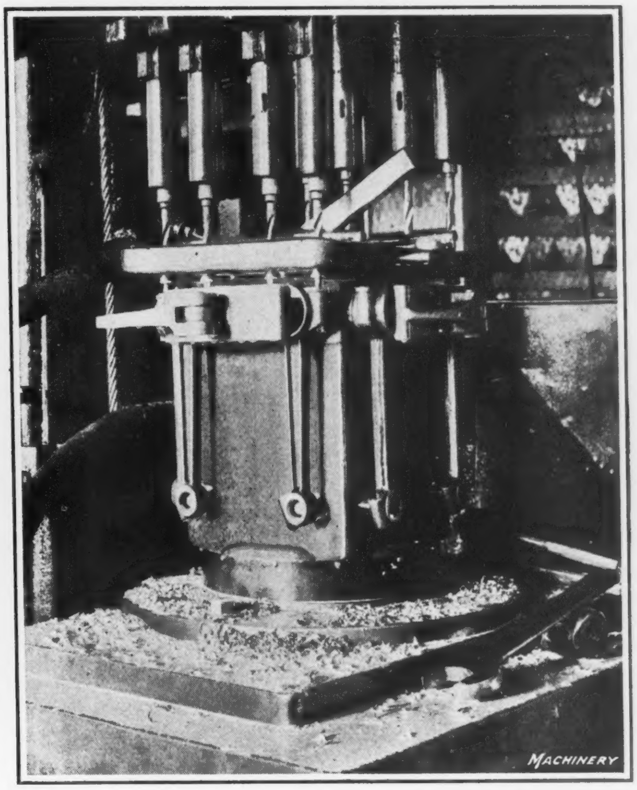


Fig. 3. Drilling Stud Holes in Large Ends of Connecting-rods

drills large enough to provide clearance for the body of the bolt. By having two groups of body drills operating at two different stations, the drilling of this part of the hole can be divided, which is desirable, since the clearance hole is longer than the part to be tapped. The large and small ends of the rods are located by plugs, and the small ends are clamped by straps. The base of the fixture has four equally spaced holes that are engaged by an index-plunger (not shown) for locking the fixture in the four drilling positions. Incidentally, the bolts which enter these holes in the connecting-rods are used for locking the wrist-pin by compressing the end which is afterward split. The idea of allowing the wrist-pin to oscillate in the piston is to obtain a larger bearing surface.

Another drilling operation on connecting-rods is shown in Fig. 3. This machine is equipped with eight drills and another fixture of the station type. There are four tap drills on one side and four larger clearance drills on the other. The holes produced in this operation are for the two studs which are used to hold the cap in place after the latter has been cut off, as explained later. The hand-lever seen at the top of the fixture operates the index-plunger for locating the fixture in the different positions. It will be noted that two rods are clamped at the large end by a single strap, which is tightened by simply pulling forward a lever having eccentric surfaces. This eccentric-lever method of clamping has been applied extensively to fixtures in the Franklin plant, as it provides a simple and rapid method of clamping parts for machining, as well as an effective means of holding them securely.

Special Attachment and Fixture for Milling Connecting-rods

The wrist-pin ends of the connecting-rods are split on one side and the caps are cut almost off by means of the special milling attachment and fixture shown in Fig. 4. The faces against which the bolt heads bear at the small ends and the nuts bear at the large ends are also milled at the same time. A gang of six cutters is used for this operation. The gang of four cutters at the left consists of two slitting saws, which mill 1/8-inch slots to within 1/64 inch of the bore at the large end, and two cutters in the center, which mill the faces for the nuts at the same time that the slots are being milled. At the opposite end there is a slitting saw and a cutter for facing the spots for the bolt head. After the forgings on the right-hand side of the fixture (as seen in this illustration) are milled, they are turned over and placed on the left-hand side in order to complete the slot-milling and spot-facing operation. The work-holding part of the fixture is supported by trunnions at the ends, and it is provided with an index-plate and plunger for locating purposes. While one lot of forgings is being milled, the operator unloads and loads the fixture. The two cutters that operate on the small end are driven from the main spindle through spur gearing and a shaft above the main arbor, which transmits motion through bevel gearing to the cutters mounted on the inclined arbor.

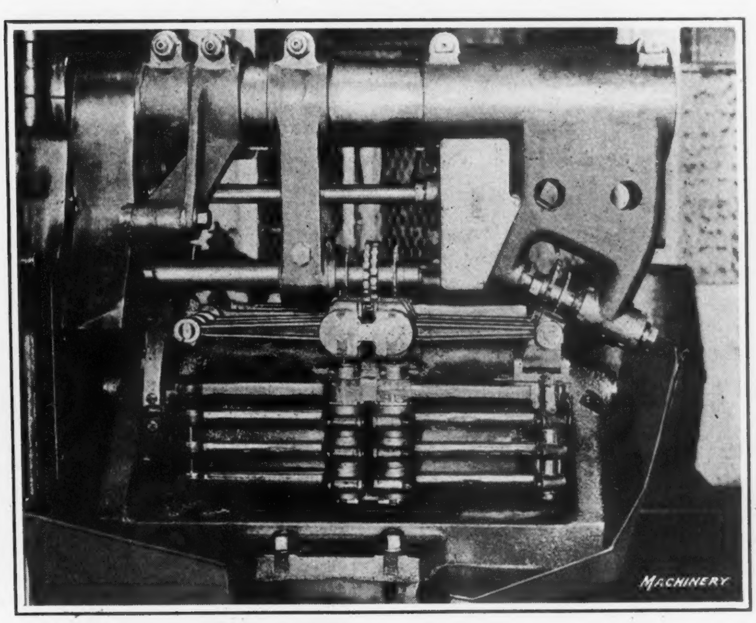


Fig. 4. Fixture and Special Milling Attachment for facing and slotting Large and Small Ends of Connecting-rods

The bolt and stud holes are next tapped on a commercial tapping machine and other minor operations performed, such as chamfering the inside edges of the large holes and removing all burrs from the outside of the rod. The caps are then severed from the main part of the rod by using a foot press equipped with a plug which enters the large hole and a shear blade which comes down and removes the thin section left by the slot-milling operation described in the foregoing.

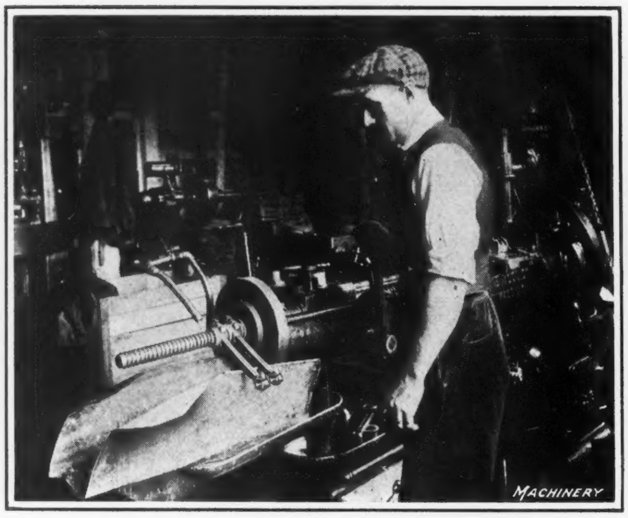


Fig. 5. Broaching the Main Bearings after Linings are in Place

Assembling Connecting-rod and Cap

After a preliminary inspection, the die-cast bearings are placed in position in the rod and cap, and the inner faces of the rod and cap joints are milled. After chamfering the stud and bolt holes, the studs are driven into the large end of the connecting-rod, an Errington stud-driver being used for this purpose. The cap and rod are then assembled, and the studs are locked by drilling pin-holes and driving in small pins which are riveted over.

Finishing the Bearing Surfaces

The first operation on the babbitt bearing surfaces is performed on a broaching machine. Two connecting-rods are broached at a time as illustrated in Fig. 5. These bearings are next accurately finished by reaming, as illustrated in Fig. 6. The small end of the rod is located by an accurately fitting plug. The large end is centrally located in the reaming fixture by another plug which is inserted temporarily through a bushing which is of the screw type and clamps this end of the connecting-rod for the reaming operation. The reamer used removes about 0.010 inch, and the teeth are without clearance so that the babbitt lining is finished very smoothly. The center-to-center distance between the large and small holes is held within a limit of 0.002 inch. This is not the final operation on the large end of the bearing, but it provides an accurate hole for locating the work while grinding the wrist-pin to size, as illustrated in Fig. 7. A Bryant chucking grinder is used for the latter operation. The work is located on the faceplate by pushing the large end over a close-fitting plug, after which an aligning plug is inserted in the small end and the latter is then held securely by means of the two clamps shown.

The final operation on the large end is illustrated in Fig. 8, which shows a special boring fixture designed for very accurate work. Before the connecting-rods are sent to this machine they are weighed so that the six rods which are used for any motor will weigh the same within close limits. While the variation in weight is not very great, this weighing of the rods in order to secure greater uniformity insures a more perfect balance, especially when the motor is operating at high speeds.

The reason for using the special boring fixture shown in Fig. 8 for taking a very light finishing cut with a single-pointed tool is to provide for fitting each rod as accurately as possible to the particular crankpin on which it is to operate. The general procedure is to first measure with a micrometer and then record the exact size of each crankpin on the crankshaft. The machine is equipped with five boring-bars varying 0.0005 inch in size, so that a bar can be selected for finishing each connecting-rod to exactly the diameter required.

The work is set up in the machine by first inserting through the wrist-pin hole an accurately fitting arbor *A*, which is supported in bearings at the ends. These bearings are carried by counterweighted slide *B*, which permits the

Fig. 6. Reaming Operation on Main Bearings

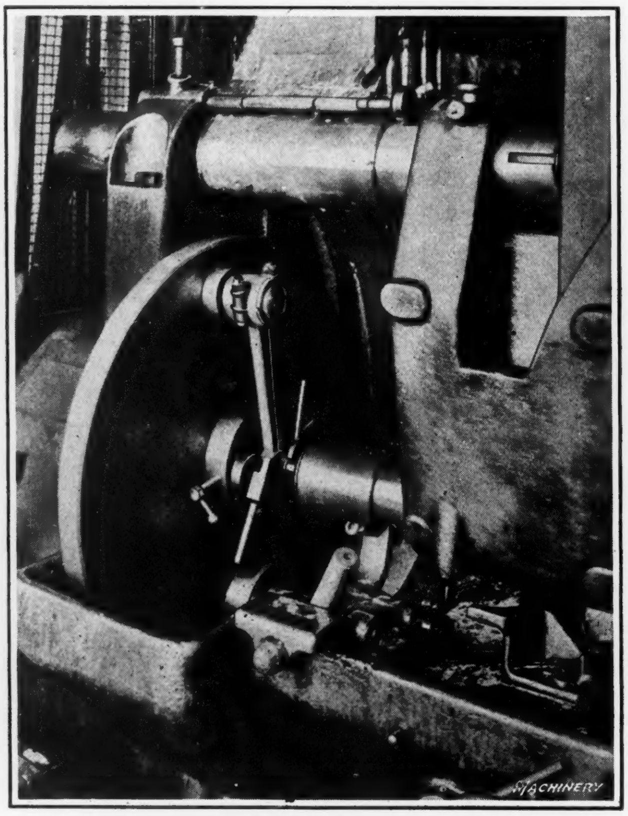


Fig. 7. Finishing Wrist-pin Hole by grinding

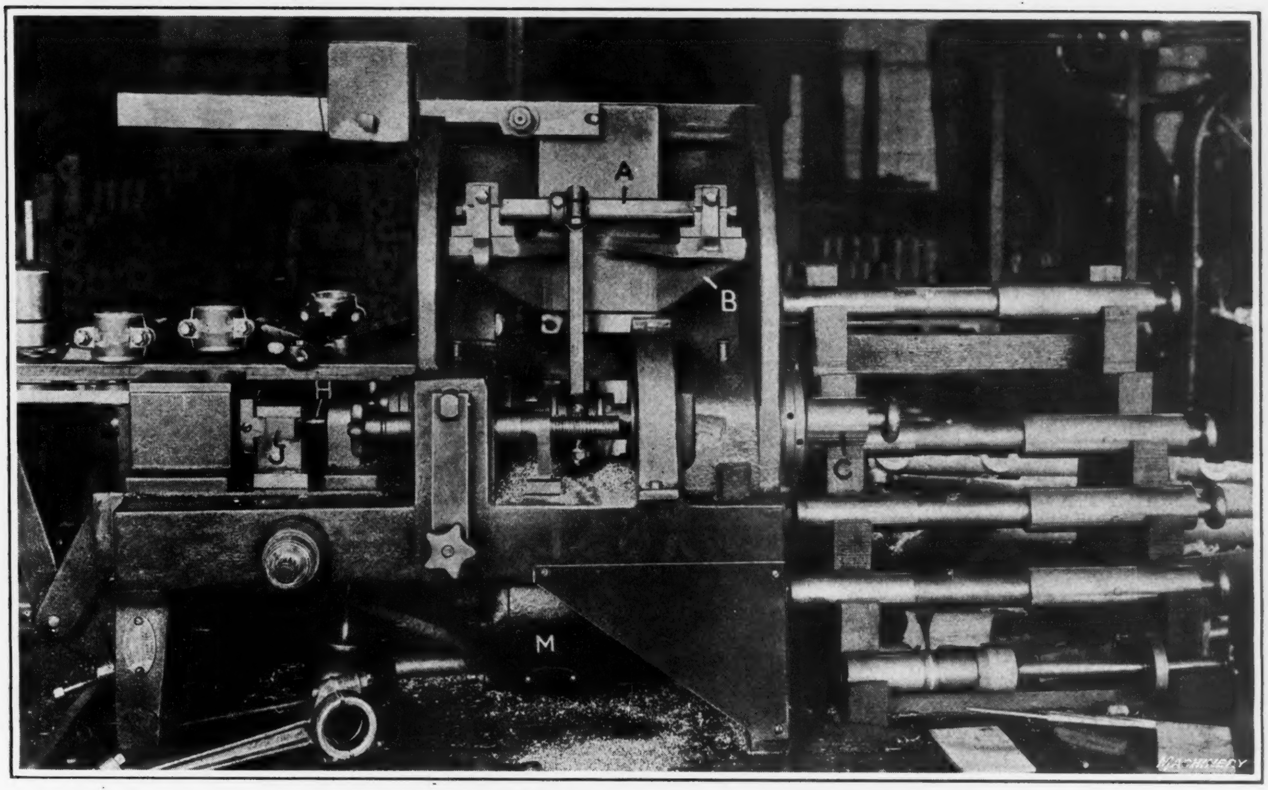


Fig. 8. Special Machine used for finishing Main Bearings of Connecting-rods

rod to be raised or lowered so that it can be accurately centered with the machine spindle, which is done by inserting a centering plug before placing the boring-bar *C* in position. The clamp used at the lower end of the rod is illustrated in Fig. 11, which is a sectional view in a horizontal plane. When nut *A* is turned, the clamping jaws *B* and *C* grip the connecting-rod *D*, but do not tend to force it out of alignment because the body *E* of the clamp is free to slide in bearing *F* and no unbalanced lateral pressure is exerted on the connecting-rod. After nut *A* has been tightened, the entire clamp is held in position by turning lock-nut *G*. The machine is driven by a small motor *M* (Fig. 8) beneath the bed, which is connected with a spindle through spur gearing. The feeding movement of the spindle is derived from a feed-screw *H* of fine pitch, which is connected with the end of the boring-bar and pulls the boring-bar forward whenever the feed-nuts or jaws *J* are thrown into mesh with the feed-screw through the operation of a foot-treadle.

Testing Accuracy of Connecting-rods

The method of testing the parallelism of the wrist-pin and crank-pin holes in the connecting-rod is illustrated in Figs. 9 and 10. Before making this test, the four dial gages on the fixture are adjusted by means of a master gage, which is placed in the fixture as shown in Fig. 9. This master gage has parallel plugs at each end. The two lower dial gages are set to zero, when they are in contact with the master gage as shown in the illustration. This master gage, which is supported by V-blocks at the inner end, is next swung upward to a vertical position so that the smaller plug is in contact with the upper dial gages, which are also set at zero.

The connecting-rod to be tested has plugs inserted through the large and small holes. These plugs are made to fit snugly by means of expanding bushings. The test is made by placing the connecting-rod and its plugs in the fixture in the same position as is occupied by the master gage. The plug through the large end rests in the V-blocks, and the plug

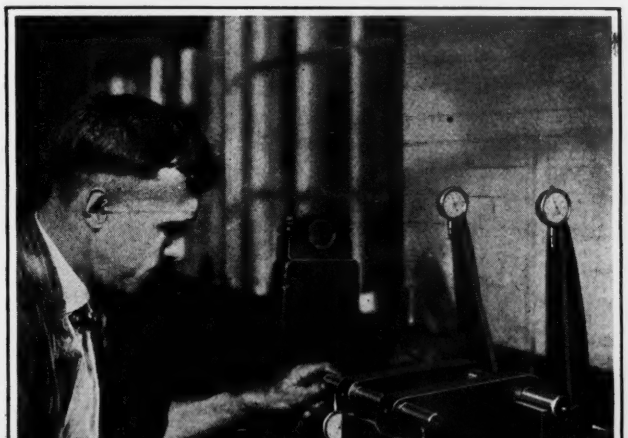


Fig. 9. Adjusting the Fixture used for testing Parallelism of Connecting-rod Bearings

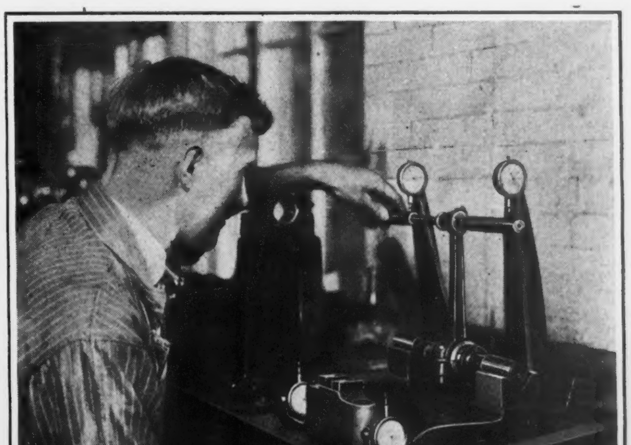


Fig. 10. Method of testing Parallelism of Connecting-rod Bearings in Fixture shown in Fig. 9

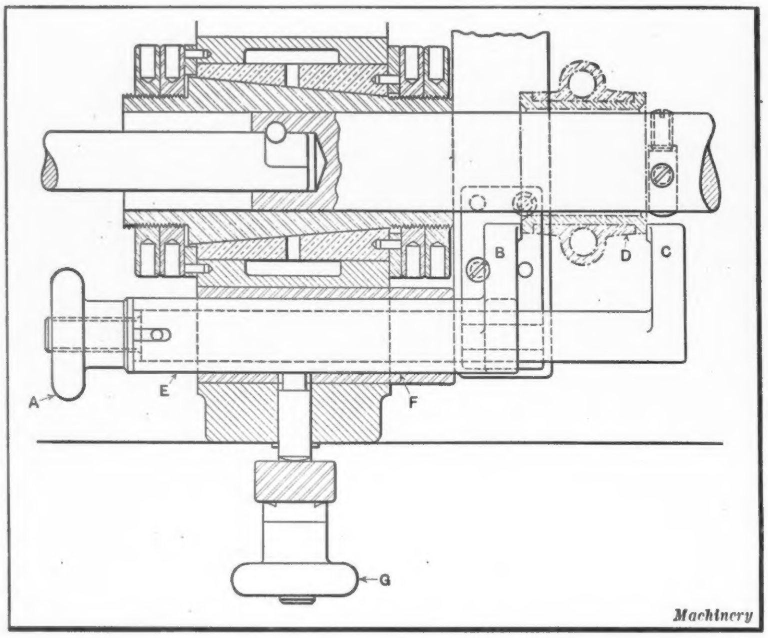


Fig. 11. Floating Clamp used on Machine shown in Fig. 8 to prevent springing Connecting-rods

through the small end is brought into contact with the two sets of dial gages, by placing the work in both vertical and horizontal positions. In this way the parallelism is tested in two planes, 90 degrees apart, and the test is a very severe one as there is a distance of 10 inches between the dial gages. A limit of 0.010 inch is allowed for the upper gages, and 0.005 inch for the lower gages, which means a very close limit in the length of the bearing itself. This gage also tests the alignment of the sides or faces at each end of the rod.

* * *

EFFECT OF RADIAL PLAY

In an article in *Mechanical Engineering*, Roland W. Sellew, research engineer of the Fafnir Bearing Co., New Britain, Conn., states that tests have recently been made by this company to determine the effect of radial play on the life of ball bearings. By radial play is meant the amount of shake or looseness between the inner and outer rings in a direction at right angles to the bore. This play is measured after the bearing is completely assembled ready for shipment, by the use of a special gage. Most users of ball bearings demand that the radial play be very small, some specifying that it shall not exceed 0.001 inch. They consider it sufficient that a bearing should run freely before being mounted and that no perceptible play exist. At first one would believe that the less play the better, as long as the bearing is free to turn. One must consider, however, that the examination or inspection of ball bearings is made before mounting and that the mountings call for a drive fit of the inner ring over the shaft, and sometimes the outer ring is also forced into its housing. Several tests were made to determine what effect this forcing of the bearings into place had. It was found that the inner rings expanded from 0.0003 to 0.0004 inch, and the outer rings contracted from 0.0002 to 0.0003 inch, these measurements being made when press fits were used.

These facts make it apparent that the radial play must be considered after the bearing has been mounted. It is of course impossible in most installations to measure radial play after the bearing is mounted, but it is quite possible to measure the expansion and contraction of the inner and outer rings. When an average value has been established for these two items, the problem is simplified. For instance, consider a bearing having a play of 0.0005 inch before mounting, and a mounting that causes an expansion of 0.0002 inch of the inner ring and a contraction of 0.0001 inch of the outer ring. The radial play after mounting will be the sum of the expansion plus the contraction (0.0001 + 0.0002 = 0.0003) subtracted from the play before mounting (0.0005 — 0.0003 = 0.0002). Hence the radial play after mounting is very different from that in the unmounted bearing.

It is quite evident that under certain conditions the bearing may be loose enough to turn easily before mounting and may be entirely too tight afterward. In order to determine whether or not a tight bearing wears out faster than a loose one a series of tests was made, the results of which are tabulated below. It must be remembered that the radial play of these test bearings was measured before mounting in the test block. The test mounting reduced the play in each case by about 0.0002 inch.

Bearing No.	Radial Play, Inches — Before Mounting	Radial Play, Inches — After Mounting	Hours Run	Remarks
1........	0.0000	Cramped	347	Failed at this time
2........	0.0000	Cramped	477	
3........	0.0002	0.0000	323	
4........	0.0002	0.0000	477	
5........	0.0004	0.0002	571	No signs of failure
6........	0.0008	0.0006	803	
7........	0.0012	0.0010	571	
8........	0.0012	0.0010	585	

These results indicate that the play should be at least 0.0005 inch after mounting. The necessary play before mounting must be determined for each condition of installation. This must be done by the user under average conditions as he finds them.

In conclusion, it may be well to point out that there is a slight variation of play in all bearings. This is due to the fact that a slight tolerance or variation must be permitted to make bearing manufacture commercially possible. This variation in radial play is usually about 0.0005 inch but for large bearings may exceed this.

* * *

CUTTER GUARD FOR HAND MILLING MACHINE

At the Smith Premier Works of the Remington Typewriter Co., at Syracuse, N. Y., hand milling machines are used for certain short milling operations on typewriter parts. A simple but effective cutter guard designed by Joseph Holden, works manager, is shown in the accompanying illustration. This guard is in the form of an arm, which is pivoted at one end and has at the other end a cage surrounding the cutter, the cage being formed of vertical rods held in a frame by cap-screws. These rods can be adjusted for clearing any part, and when the cutter is not revolving the guard can be swung back out of the way, a stop being provided for holding the guard in a convenient position.

Adjustable Type of Cutter Guard for Hand Milling Machines

Letters on Practical Subjects

UNUSUAL METHOD OF HANDLING DRILL JIG

An unusual purpose for which a Wiard chuck is being used in an automobile plant is to assist in placing a heavy jig on work and in removing it upon the completion of an operation. The jig is shown in Fig. 1 at *A*, in place for drilling holes in the bottom of a cylinder casting. In designing this jig, the problem of lifting it on and off a casting gave considerable trouble owing to its weight. Finally the scheme described in the following was thought of, with the result that the handling of the jig is accomplished without difficulty.

A Wiard chuck holds the drills used in the operation, and stud *B*, having the same dimensions as the collets used for holding drills in this chuck, is placed at the center of gravity of the jig. This stud has a groove in which the rollers of the chuck are placed by means of the sliding sleeve used to obtain their movement, so that when the spindle of the machine is raised, after the stud and rollers have become so engaged, the jig is lifted with it. The completed work can then be removed from the bed and an unfinished casting substituted, after which the jig is lowered on the new casting, the rollers released from the stud groove, the spindle lifted, and a drill inserted in the chuck for the performance of the next operation.

Fig. 2 shows the jig in a position several inches above a cylinder casting mounted on the machine bed. The groove in the lifting stud permits the jig to be swiveled about the machine spindle. In order to clearly understand the method of locking the lifting stud in the chuck, it is essential for the reader to have a knowledge of the construction of the chuck under discussion.

Detroit, Mich. JOSEPH LANNEN

MECHANICAL MOVEMENT OF NOVEL DESIGN

The accompanying diagrams illustrate an unusual mechanical movement employed on a machine which manufactures flat steel heddles used in weaving cloth. Referring to Fig. 1, the problem encountered by the designer was as follows: The grooved end of lever *A*, which is carried on shaft *B*, was required to travel from *C* to *D*, a distance of 10 inches. In its travel, lever *A* must completely reverse its position, and it must be so guided during the last half inch of its travel that the groove in the end will pass over a wire carried at the height of center line *XY*. As lever *A* is only 3¾ inches long, a half revolution of shaft *B*, on its center, would cause lever *A* to fall 2½ inches short of the required distance. To overcome this difficulty, shaft *B* is made to travel, in addition to reversing its position.

This is accomplished by means of a pinion *E*, Fig. 4, which is keyed to shaft *B*. This pinion meshes with a gear segment *F*, carried on lever *G*. Lever *G* is carried on shaft *H*, but does not turn with it, being normally held in the position indicated in Fig. 1 by a heavy spring *I*. Lever *J* is keyed to shaft *H* and carries shaft *B* at its upper end. Shaft *H* is given a partial revolution, receiving its motion from a cam

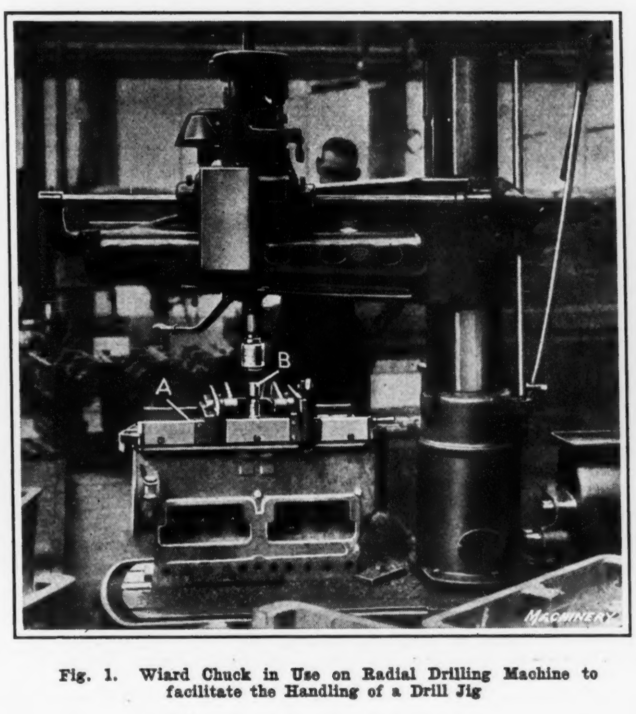


Fig. 1. Wiard Chuck in Use on Radial Drilling Machine to facilitate the Handling of a Drill Jig

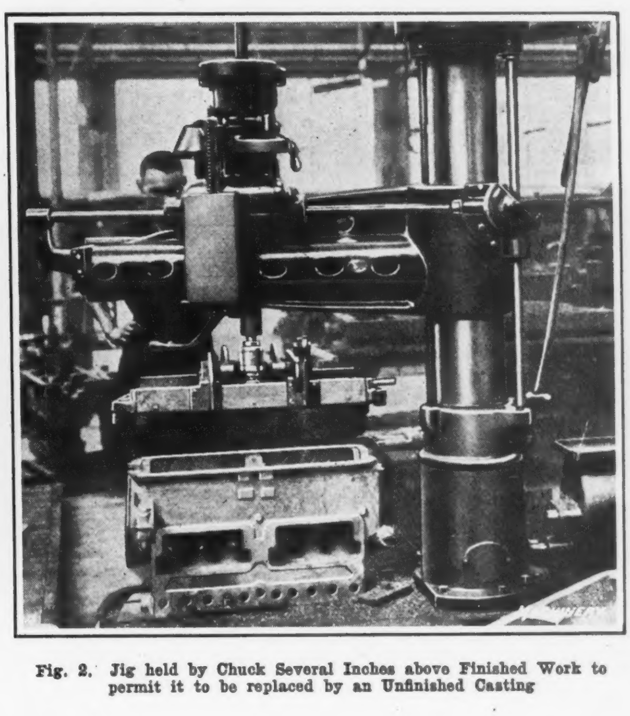


Fig. 2. Jig held by Chuck Several Inches above Finished Work to permit it to be replaced by an Unfinished Casting

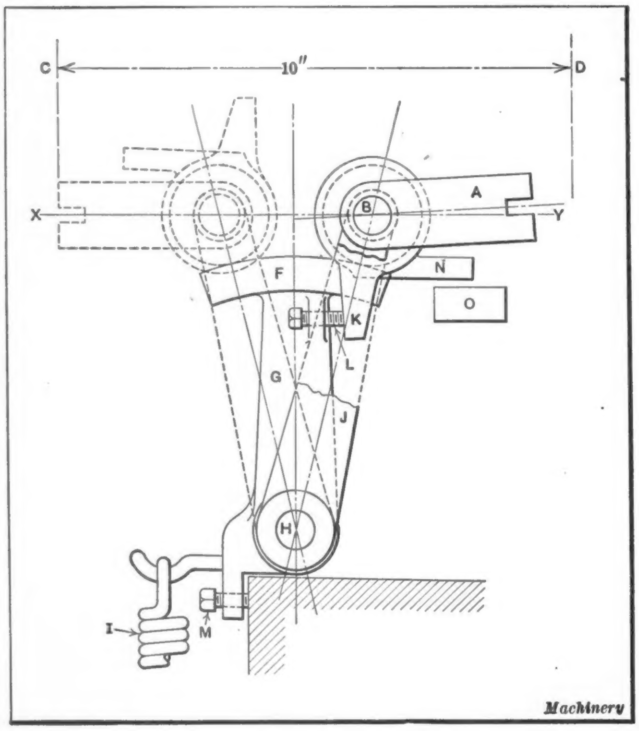


Fig. 1. Diagrammatic View of Unusual Mechanical Movement

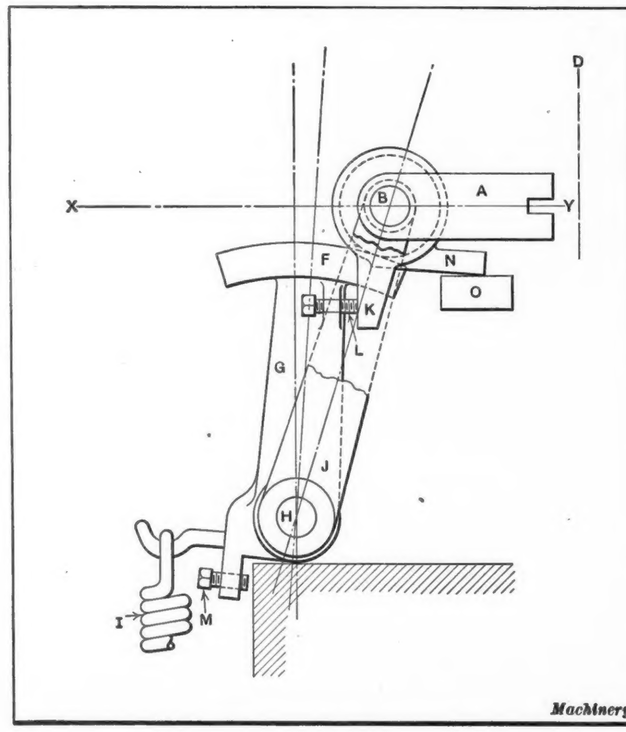


Fig. 2. Lever A in Position resulting from Initial Movement of G

at the back of the machine. This causes lever J to oscillate, and the forward motion of shaft B causes pinion E to rotate, tending to reverse lever A from the position indicated by the dotted lines to that indicated by the full lines in Fig. 1. Before lever A has completely reversed its position, the stop K, which is keyed to shaft B, comes in contact with set-screw L, which is carried on a lug on lever G. Lever J is partly broken away in Fig. 1 for clearness. The cam follower, however, has not reached its highest point when the stop comes in contact with the set-screw, and so causes a further rotation of shaft H. The continued motion of lever J tends to rotate shaft B further, but as this is prevented by stop K, the lever G, carrying segment F, is forced to oscillate with lever J. This is shown in Fig. 2, in which it will be seen that the set-screw M is lifted away from the bed of the machine.

In Fig. 1, the stop N is slightly above the bar O; while in Fig. 2, stop N has moved forward and lowered, until its end is in contact with O. This is caused by the oscillation of lever G. The slotted end of lever A is now one-half inch from its desired position and has completely reversed its position. Continued movement of levers G and J cause stop N to lower at the back until, at the end of the stroke, stop N rests flat on bar O, as shown in Fig. 3. From this illustration it will be seen that lever A is lower at the back end, though the center of the groove in the outer end of lever A has moved in a line parallel with the base of the machine, which is the essential point.

It should not be assumed that the entire lever A must travel in a straight line, as this is not necessary. The height of the wire which the slot is required to pass over never varies above or below the center line XY, though it may vary from line D. For this reason, the groove in the end of lever A must be in position to pass over the wire at any point in the last half inch of its travel. Fig. 4 is a front view showing the arrangement of the parts. The stop N cannot be

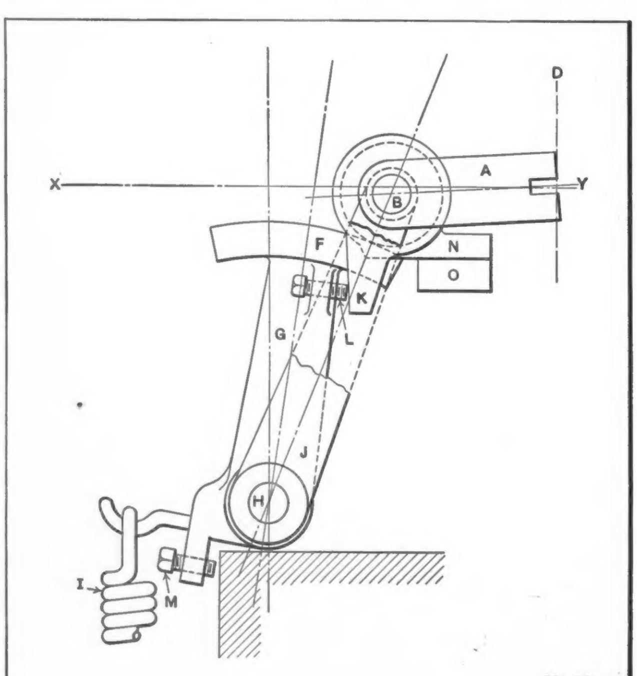


Fig. 3. Lever A at Extreme Right-hand Position

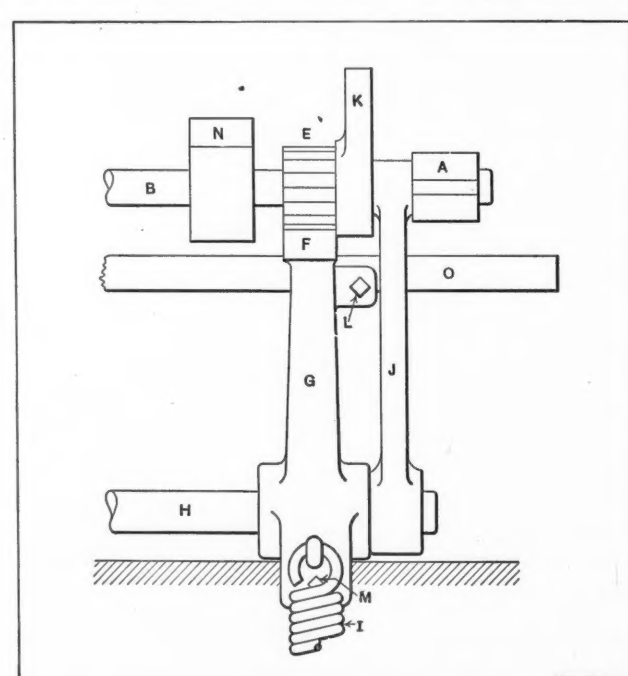
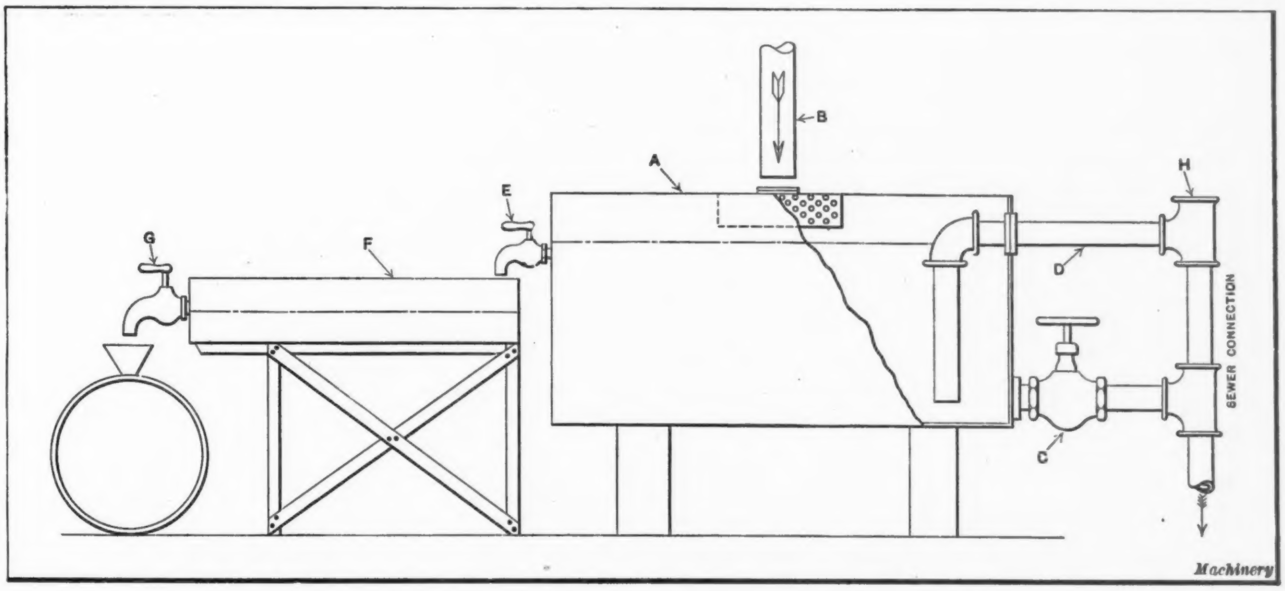


Fig. 4. Front View showing Arrangement of Parts of Mechanism



Apparatus for reclaiming Oil from Sal-soda Solutions used on Screw Machine Parts

keyed to shaft *B*, as it must be adjustable. Stop *K* is non-adjustable and therefore can be keyed. The rotation of shaft *B* is stopped by stop *K* so that the contact between *N* and *O* will be gradual. Were stop *N* permitted to prevent further rotation of shaft *B*, it would soon become loose or lose its setting.

Philadelphia, Pa. R. H. KASPER

RECLAIMING OIL FROM CLEANING SOLUTIONS

In the manufacture of parts in automatic screw machines there is always a certain amount of cutting oil that adheres to the parts; this is especially true in cases where cutting oils of the heavier variety are used in connection with the machining operation. It is desirable to remove this oil prior to inspection, and the method formerly followed for accomplishing this in the plant where the writer is employed was to immerse the parts in a hot sal-soda solution. The oil that rose to the surface of the solution was subsequently skimmed from it and used again. At the present time, however, the cleaning solution is contained in a washing machine provided with a conveyor for carrying the work through the bath. When it is desired to remove a dirty solution from this machine, it is emptied into the apparatus shown in the illustration, by means of which the oil is reclaimed.

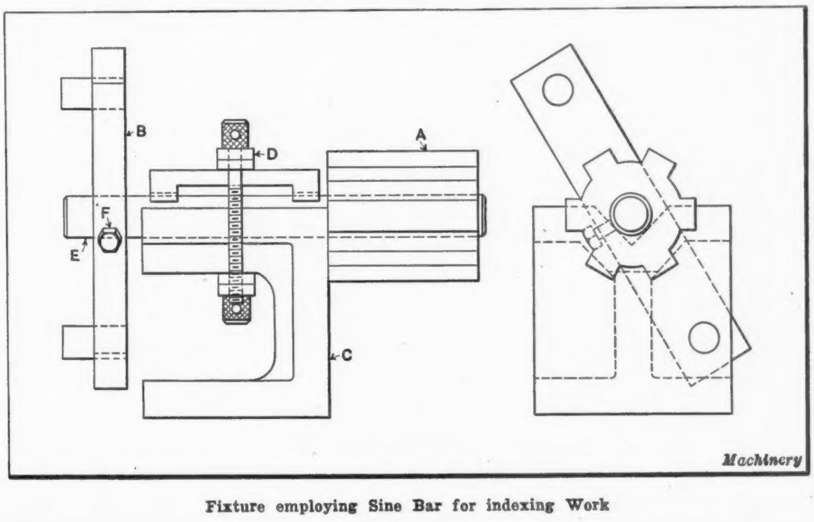
The solution is discharged into the settling tank *A* from the drain pipe *B* of the washing machine. Prior to this step, any water in the tank is drained from it by opening valve *C* which permits the water to run into a sewer connection. When the solution being discharged into the tank reaches the level of pipe *D*, it begins to overflow through this pipe, but as the oil contained in the solution rises to the surface, it is not carried away by the pipe, because the latter has its inlet near the bottom of the tank. Faucet *E* is opened at intervals as oil collects at the top of the solution and so drains it into the oil settling tank *F* from which it is again drained into drums through faucet *G*. The oil is later run through filters to effect the removal of all chips which may still be contained in it.

It was found necessary to place a screen beneath the outlet of drain pipe *B* to prevent excessive agitation of the solution as it enters tank *A*, which formerly caused the loss of a considerable portion of the oil. Pipe *D* is placed about 8 inches below the top of the tank to provide for a surplus of the solution in the tank during the settling of the water. The upper end of tee *H* is left open so that the solution will not be siphoned from the tank when it reaches a level above that of the overflow pipe. Tank *A* is cleaned of small chips and other refuse about once a month. The sal-soda solution used for cleaning tote pans, and the drippings from the washing machine are also run through this oil reclaiming apparatus. The arrangement described works satisfactorily and saves approximately three barrels of oil per week from parts manufactured on 200 automatic screw machines and 70 hand screw machines.

Flint, Mich. CHARLES E. HENDRICKS

SINE BAR INDEXING FIXTURE FOR GRINDING SPLINE GAGE

The fixture shown in the accompanying illustration is designed for use in grinding spline gages and work of a similar nature requiring a number of accurate divisions. In this instance gage *A* with six equally spaced splines is the work that requires grinding. At *B* is a sine bar bored in the center to fit the end of arbor *E*. The sine bar is clamped to the arbor by set-screw *F*. The angle-plate *C* is of the box type with a vee ground on its top surface. The sine bar can be made of any convenient length, but the longer it is, the greater will be the accuracy obtained by its use.



Fixture employing Sine Bar for indexing Work

After the gage has been roughed out and hardened, the hole is ground and

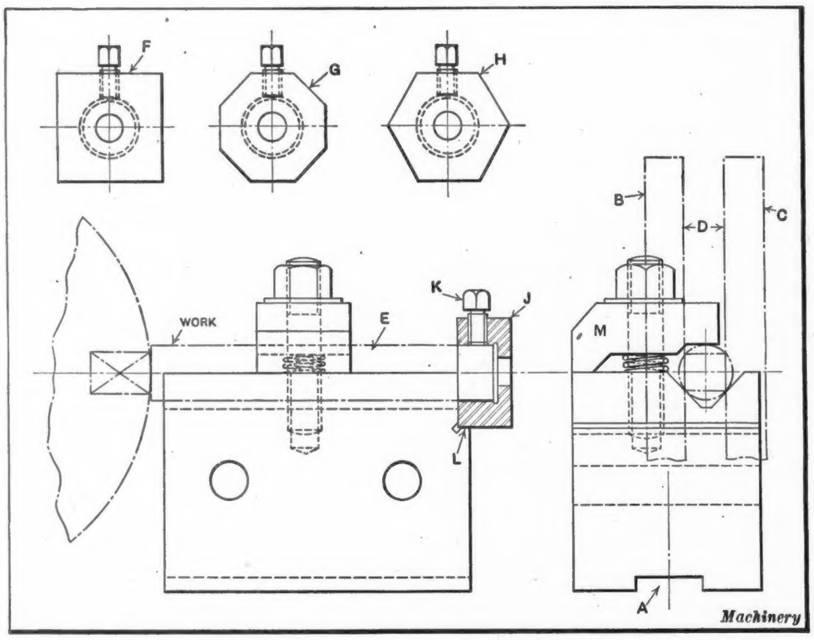
lapped to a snug fit on the arbor; then the outside diameter and the splines are ground. The gage is placed on the arbor, which is clamped in the vee with a parallel clamp *D*, using a block on top of the arbor that has bearing points at each end to insure proper alignment of the arbor in the vee. The sine bar is placed on the opposite end of the arbor, and is lined up parallel with the base of the angle-plate by means of the buttons and an indicator, care being taken to see that the gage has two of its splines in alignment with the sine bar. The fixture is then placed on the surface grinder, and the upper sides of the two teeth in alignment with the sine bar are ground. The gage is next given half a turn, lined up again by means of the sine bar, and a cut taken on the opposite sides of the teeth without changing the vertical adjustment of the grinding wheel. The width of the teeth is then measured with a micrometer, and the amount of stock yet to be removed determined. The teeth should be first ground to within two or three thousandths inch all around before finish-grinding.

After the two teeth in alignment with the sine bar have been ground on both sides the sine bar can be released on the arbor by loosening set-screw *F*. It can then be locked in a position which will give the required setting for grinding two of the other teeth when clamp *D* is released and the sine bar again brought into a position parallel with the surface plate. The sine bar may be set at the proper angle by means of a height gage, or special size blocks may be used. As the sine bar is much longer than the diameter of the gage, slight errors made in setting the sine-bar are hardly noticeable on the work.

Beverly, Mass. JOHN T. CLARK

MILLING FIXTURE FOR SQUARING END OF ROUND SHAFT

The fixture shown in the accompanying illustration is designed for use in forming a section of either square, octagonal, or hexagonal shape on the end of a round bar by straddle-milling. The method of using the device is as follows: The fixture is clamped to the milling machine table, after first being lined up by means of the standard key-slot *A*. Cutters *B* and *C* are then placed on the arbor and set so that distance *D* between their cutting faces equals the distance across the flats required for the square, hexagonal, or octagonal shapes. To square the end of a shaft *E*, a block *F* is slipped on one end of the work and held in place, as shown in the cross-sectional view at *J* by set-screw *K*. The shaft is slipped along the vee until one edge of the square block rests on the ledge *L* of the fixture. The clamp *M* is then tightened and the work fed toward the cutters, thus milling two sides of the square. The work is then withdrawn from the cutters, the clamp loosened, and the work slid back in the fixture to permit it to be rotated 90 degrees until another side of the square block lines up with ledge *L*. The shaft is again pushed in so that the block rests on the ledge, the clamp tightened, and the work again fed forward. This completes the squaring operation, and the piece can be removed and a new piece placed in the fixture.



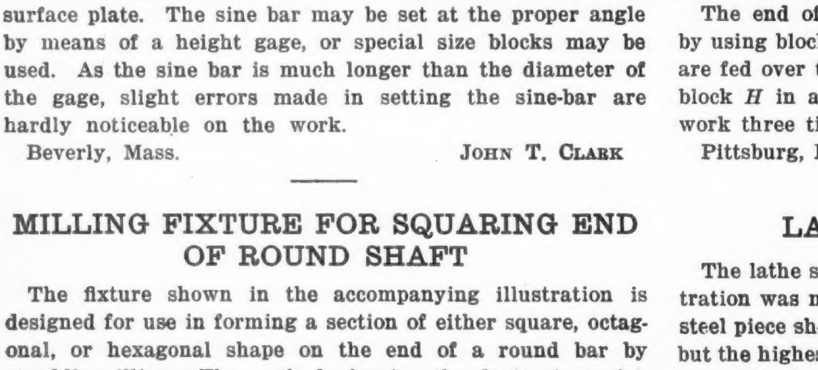
Fixture for milling Section of Square, Hexagonal, or Octagonal Shape on the End of a Round Shaft

The end of the work can be milled to an octagon shape by using block *G* in the same manner, except that the cutters are fed over the work four times instead of twice. By using block *H* in a similar manner, but passing the cutters over work three times, a section of hexagonal shape is obtained.

Pittsburg, Pa. WILLIAM OWEN

LATHE SLOTTING FIXTURE

The lathe slotting fixture shown in the accompanying illustration was made for use in cutting the slot in the machine-steel piece shown at *A*. This slot had previously been milled, but the highest production rate obtained by milling was easily exceeded by the use of the fixture shown, which made it possible to slot twelve pieces at one time. The clamping pieces *B*, which locate and hold the work, were turned up as one solid piece, and the twelve holes for holding the work drilled and reamed to proper size, after which the solid piece was cut in two, thus forming the two pieces. Arbor *C* was turned to fit the arbor holes through pieces *B* and threaded to receive flanged nut *D*. Care was taken to drill the radial holes exactly in line with each other, and also to make these holes a close fit for the work, as otherwise the slots in the pieces would not all be central and the fixture would not tighten up evenly on all the pieces.



Lathe Slotting Fixture designed for slotting Twelve Pins at One Time

Two dowels fitted tightly in holes drilled in arbor *C* and made a close sliding fit in corresponding holes in clamping pieces *B*, serve to keep these parts in alignment. In loading the fixture, one of the pieces is inserted and nut *D* screwed up until it holds the piece lightly, after which the lathe spindle is turned around to facilitate loading all twelve holes, by pulling on the drive belt. When completely loaded, the pieces are secured by tightening nut *D*. To unload the fixture, the nut is loosened a half turn, and the lathe spindle given a complete revolution by pulling on the belt so that all the pieces fall out into a chute which conveys them to a box. Although a bumping action is produced in this operation, the final result is a smooth

clean slot. It may be well to mention that for this particular job there was no objection to the curved surface produced at the bottom of the slot.

Rosemount, Montreal, Canada — HARRY MOORE

SAVING COMPUTATIONS FOR FUTURE REFERENCE

Computations which may prove of future value should be made on sheets of one size and filed in a book where they can be readily located when desired. A suitable loose-leaf book for the purpose is illustrated in Fig. 1. Index tabs are provided so that a sheet can be filed according to the information which it contains. One of these books might suffice for an entire department; however, each computer could be furnished with one if this should prove necessary. In making mathematical calculations, many persons show every step on the sheet which is to be saved, so that finally the sheet becomes covered with a mass of figures that is quite unintelligible to a fellow-worker. The division, multiplication, and squaring of numbers, etc., should be made on a paper which can be later destroyed, and only sufficient information should be given on the sheet kept for reference to indicate the method of obtaining the result. The latter should be marked conspicuously so that it can be seen immediately, and all information should be given in such a manner that it can be easily understood by others.

An example of a computation sheet is illustrated in Fig. 2. The upper portion of the sheet shows a sketch of a punching, the teeth of which are tested by means of a plug *P* placed between them. The horizontal center line of this plug must coincide with the pitch line (P.L.) of the teeth. The problem is to find what diameter plug *P* should be, and to determine dimension *Z*, and the magnitude of one-half the included angle of the sides of the teeth. The method followed in calculating these values is shown in the lower part of the sheet. Lead lines, such as *J*, *K*, and *L*, are employed to show how each figure entering into a calculation is obtained, and reduce the number of figures to a minimum; see (B), (C), and (H), Fig. 2. These lines should not cross each other, but when this cannot be avoided, a small loop should be made on one of the intersecting lines, as shown on line *K* where it crosses line *L*, so that there can be no misunderstanding as to the figure or angle that a line leads to. Each result sought should be the last line of a column of figures leading to it, as shown at *F*, Fig. 2. The results obtained are heavily underscored so that they can be quickly distinguished.

It will be noted that a symbol number is given at the top of the sheet, and so this sheet should be filed in the book under the division alloted to symbol numbers. The name of the computer and the date on which the calculation was made should always be written at the bottom of the sheet. When it is necessary to make another calculation for the same job after a sheet has been filed, the computation should be made on the original sheet if this is possible, in order to keep all calculations for one job in a compact form. In cases where a sketch is required with the calculations and it is desirable to trace it from another drawing, a sheet of tracing paper may be used to facilitate this. It is always preferable to explain everything possible by means of sketches rather than by words.

Reading, Pa. — B. SPECTOR

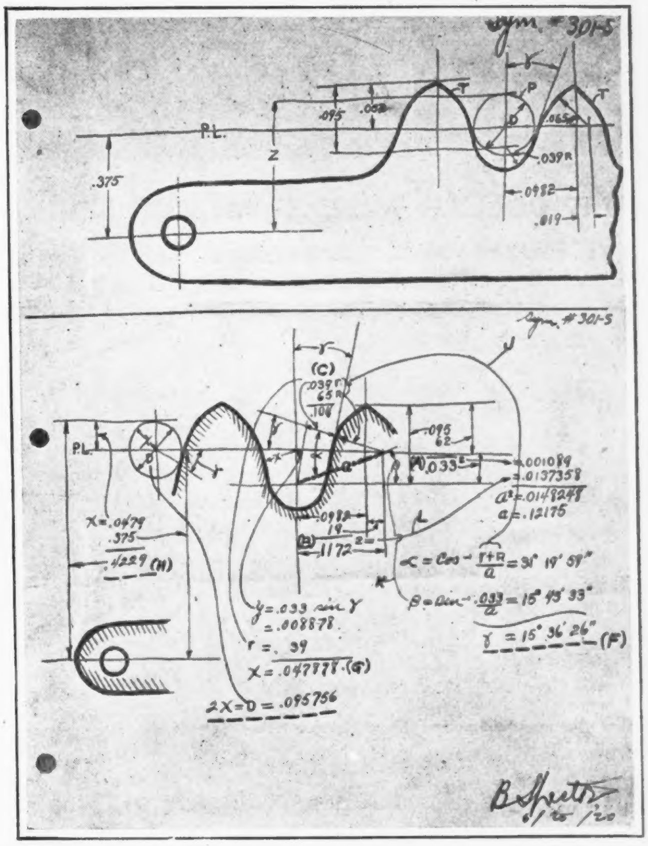


Fig. 2. Typical Calculation Sheet for Book prepared in a Manner to permit Information to be easily understood

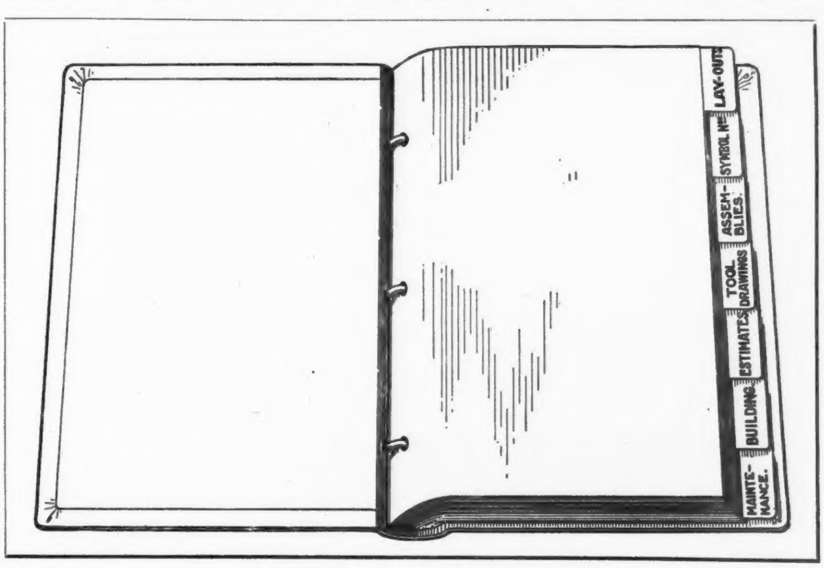


Fig. 1. Computation Book conveniently arranged for keeping Sheets in Orderly Condition

* * *

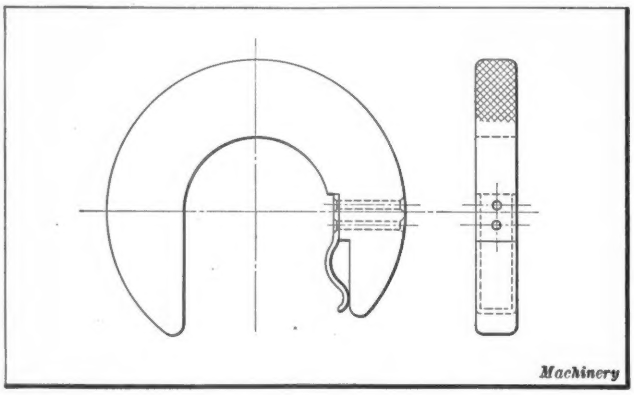
COURSE IN INDUSTRIAL ENGINEERING

A new professional course in industrial engineering has just been announced by Columbia University, the purpose of which is to give engineering students a broad conception of the problems met with in actual industrial production and in the management of engineering undertakings. The studies are grouped under the headings General Engineering, Business, Machinery, and Industrial Work. Under the heading Industrial Work, four months' work is required in a factory, half the time as a worker in the shop and the remainder in study and analysis of methods and processes. Mechanical operations are analyzed and the characteristics of machines examined. In the third year of this course each student selects and studies, under guidance, some particular industry. The study will include a survey of commercial, financial, and technical factors, with contemplation of ways and means for improvement. A final course aims to develop methods of analysis by which the machinery and equipment may be selected for manufacturing an assigned commodity according to an assumed schedule. A part of the job is the preparation of a financial budget for the undertaking.

SHOP AND DRAFTING-ROOM KINKS

SLIP COLLAR WITH RETAINING SPRING

The accompanying illustration shows a slip collar designed for use on a revolving arbor, a flat spring of special shape being provided to prevent the collar from being thrown off

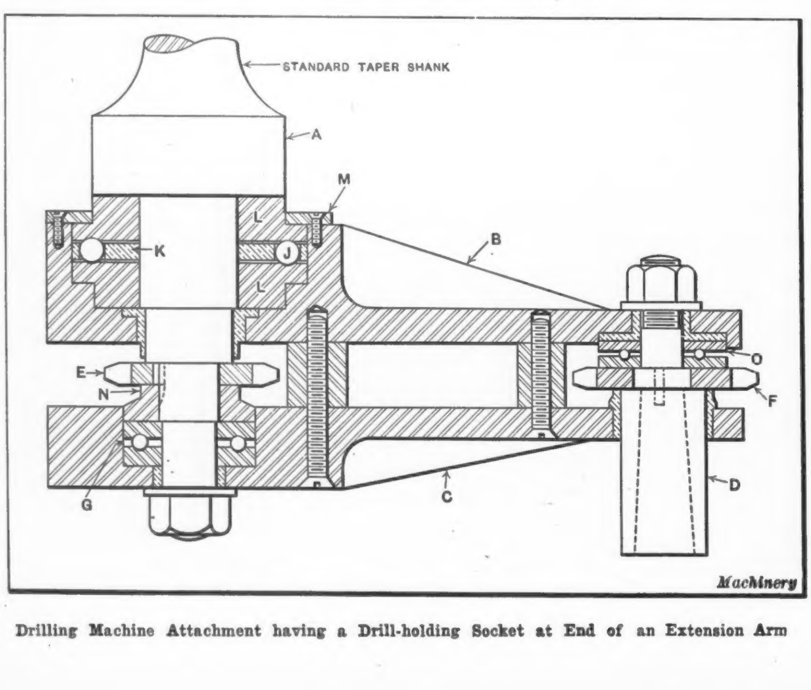


Slip Collar of Special Design

the arbor as the latter rotates, in the event that the nut locked against its face should become loose. This spring does not interfere with slipping the collar on or off the arbor in the usual manner. F. SERVER

ATTACHMENT FOR DRILLING IN INACCESSIBLE PLACES

Occasionally the drilling of holes in certain places on a casting is impossible because of an overhanging edge on the casting or some other feature in the design which prevents the drill held in the customary socket in the drilling machine spindle from being placed in position for the operation. The illustration shows an attachment developed for overcoming this difficulty. It consists essentially of a spindle *A* having a standard taper shank on the upper end to fit the socket in the spindle of the machine, two arms *B* and *C* which are attached to spindle *A*, and socket *D* which is supported at the opposite ends of the arms. When the machine is in operation, socket *D* is driven by spindle *A* through a



Drilling Machine Attachment having a Drill-holding Socket at End of an Extension Arm

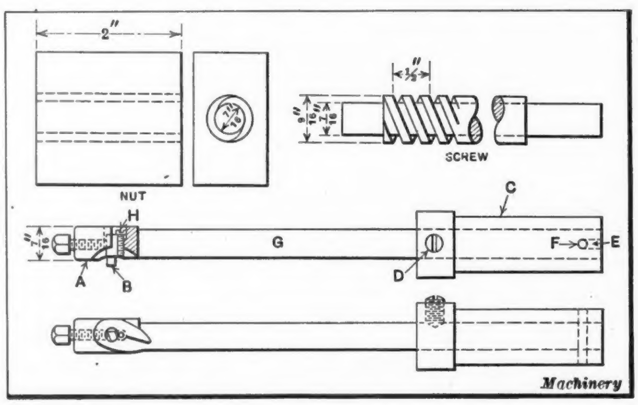
chain traveling over sprockets *E* and *F*, which are keyed respectively to the spindle and socket. It is obvious that the arms permit the drill to be extended under edges or similar obstructions on a casting.

The thrust of spindle *A* is taken by a ball bearing *G* in the lower arm, and a set of balls *J* in the upper arm, which are held in place by retainer *K* and rotate against plates *L*. This unit is secured in the arm by plate *M*. Spacer *N* holds sprocket *E* in the proper location. A ball race *O* is also placed above the sprocket on socket *D* to overcome friction when a hole is being drilled.

Chicago, Ill. H. A. PEARSON

A SPECIAL THREADING TOOL

The writer was recently required to make the nut and screw shown in the upper part of the accompanying illustration. The threads in the nut presented a problem of some difficulty, since the diameter of the hole was rather small for a double thread and consequently difficult to cut. In



Nut and Screw, and Special Threading Tool made to cut the Threads in the Nut

threading the nut, a special tool was made in the form of a boring-bar, as will be seen by referring to the illustration, the end of the bar *A* being of the same diameter as the root diameter of the thread so that it acted as a pilot. It will be seen that the cutter was provided with means of adjustment as required for taking the successive cuts. The shank *G* of the tool was held in holder *C* through the medium of screw *D* and a pin *F* passing through the slot *E*. The tool was held in the toolpost of the lathe by means of a boring-tool holder of the Armstrong type. In mounting the work preparatory to cutting the thread, an angle-plate was bolted to the faceplate of the lathe for convenience in clamping the work in place for the threading operation.

After the hole was bored to the proper size, the special threading tool was placed in position and the first cut was taken. At the completion of the first cut, screw *D* was released and the bar pulled through the work and then relocated in the holder. With the cutter suitably adjusted by means of screw *H* the next cut was taken in a similar manner, this process being repeated until the work was finished.

Paterson, N. J. S. COURTER

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, December 11

THE coal strike that lasted long enough for all industries to be seriously affected has now been settled. Many engineering firms are again getting into their stride after a compulsory period of short hands or short time, but it is questionable whether the losses can be caught up. In the machine tool trade generally the amount of business done continues to be small. Many makers are working to stock on standard lines, and short-time working has in many cases been adopted. A fair amount of inquiry is being received from Japan for machine tools, and several important shipments have recently been made to that country. It is of interest to note that a well-known Glasgow firm is executing an order for boring machines for use in a large American steel works.

Second-hand tools continue to be offered in fair quantities, though several instances are noted where prices have depreciated considerably. In the magneto industry, a trade which is now of great importance to the Birmingham, Coventry, and Rugby districts, manufacturers are experiencing considerable competition from the German organization which formerly had control over the world's trade in magnetos. With the market in its present condition, this organization has opportunities of underselling home makers, which it would not have under normal conditions.

In the Sheffield district steel is being offered by Germany in the form of billets at £9 per ton below the local prices. However, in the Midland district a fall in the price of pig iron has definitely begun, and a reduction of 10 shillings from the ton price is noted in some districts. An order has recently been placed by the government of New Zealand with Cammel Laird & Co., Ltd., for 2500 railway cars, the total value of which is stated to exceed £800,000.

Export and Import Trade

As often happens the export and import trade of the country shows no decline during the strike period, but rather an upward tendency. The trade returns for October showed an increase in both value and tonnage of exports and imports in machine tools over those for September. Under the Overseas Trade (Credits and Insurance) Act, Parliament has provided that credits may be accorded up to an aggregate amount not exceeding £26,000,000 in respect to exports of British manufactured goods to the following countries: Finland, Latvia, Esthonia, Lithuania, Poland, Czecho-Slovakia, Serb-Slovene state, Roumania, Georgia, and Armenia. Bulgaria has recently been added to the list, and other countries may possibly be included as occasion arises. Under the scheme as originally framed, advances were made by the department up to only 80 per cent of the cost of the goods, including freight and insurance, and commission paid to the Exports Credit Department, such advances being without recourse against the exporter. The department is now authorized to advance in approved cases up to 100 per cent, retaining recourse against the exporter to the amount of 20 per cent. Credits may be granted up to a maximum period of three years.

Labor Conditions

During the last month employment in the engineering trades showed a decline. The period of the coal strike saw some firms avoiding discharges of men by working for only three or four days a week, but many were compelled to close down. Coupled with the coal strike were the delivery delays asked for by consignees, and both these conditions have had a depressing influence on employment. Trades unions representing about a million and a half workers reported that the end of October saw 5.3 per cent of their number without work. But for the short time referred to above, these figures would have been considerably higher. The paralyzing effect of trade union restrictions on output is a factor which must be reckoned with. Instances are not wanting where men who have been in the habit of getting a certain wage in a five-and-one-half-day week have earned the same amount by piece-work in a short-time week of three days. On several works extensive development has been held back by the bricklayers' union stipulation of 300 bricks per day and no more, despite the fact that a short time ago the same men on the same job were laying 1000 bricks per day.

New Tools and Developments

A new universal relieving lathe has been placed on the market by Ward, Haggas & Smith, of Keighley, which has a distance between centers of 11½ inches. The outstanding feature of the design is the worm drive to the spindle. This avoids backlash and insures relief of perfectly regular contour. An automatic copying mechanism can be used on the machine when only a small number of similar pieces require to be machined, and in such cases saves the manufacture of a form tool. The lathe will swing 18½ inches over the saddle or 13½ inches over the relieving slide.

The Lumsden Machine Co., Ltd., Gateshead-on-Tyne, is making a new vertical-spindle surface grinder for flat surfaces up to 24 inches by 12 feet. Two other new grinding machines are being made by this company; one, intended for constructional work, is specially applicable to grinding flat surfaces or girder ends after the members are jointed together. A 24-inch segmental grinding wheel is used. The other machine is a horizontal surface grinding machine for surfaces up to 20 by 72 inches. The wheel mounting is novel, since it is carried in an eccentric bushing which is rotated for applying feed. The firm is also developing a 6-foot vertical grinding machine, designed along the lines of a vertical boring mill. The work is mounted on a rotating table, and the wheel is carried in a ram operating in an intermediate cross-slide. The machine is suitable for grinding either flat surfaces or internal and external cylindrical surfaces. Taylor, Taylor & Hobson, Ltd., Leicester, are making a microscope especially designed for measuring Brinell indentations.

The Stalker Drill Works, Ltd., Sheffield, have built a new factory in which gear-cutters and hobs will be manufactured. Sanderson Bros., & Newbould, Ltd., Sheffield, are making large works extensions in order to increase their output of tungsten steel hacksaw blades.

Shipbuilding and Engineering Exhibition

The Glasgow shipbuilding, engineering, and electrical exhibition, promoted by the Glasgow Corporation, was opened at Kelvin Hall on November 8 and continued until December 4. Kelvin Hall has a floor area of fully 200,000 square feet, or 20,000 square feet more than the space available at Olympia. The whole of this space was occupied by 317 stands, representing some 300 exhibitors. About 200 additional firms who desired representation had to be turned away. While most of the firms exhibiting were from the Clyde area, all parts of Britain were represented, particularly the London, Birmingham, Sheffield, and Tyne districts, and a number of foreign firms were represented as well.

Trend of Automobile Manufacturing Practice in England

By RALPH E. FLANDERS, Manager, Jones & Lamson Machine Co., Springfield, Vt.

The automobile industry in both Europe and America has been passing through a crisis in the last few months. While the final solution of the problems involved is not yet in sight, the author of this article has drawn certain conclusions relating to the industry during a recent visit to England and France, where he had an opportunity to see conditions in the automobile-building field and to obtain first-hand information. Mr. Flanders' impressions regarding the trend of automobile manufacturing practice in England and France are presented in this article.

MASS production is an expression constantly on the lips of English shop managers. This is understood to be an American phrase or, at least, an American principle, though I do not remember having heard the term used here. The idea is plain enough to understand. It is that of making the product in a sufficiently large mass to take advantage of the latest and most refined production methods for the sake of reducing the cost to the lowest possible figure. Some English automobile shops have been reorganized on this basis, and the most successful of them would produce an output that would be fairly appalling if they were running full time and full force on the plans for which they were laid out. The output would not, of course, be appalling in America, but it would be in Great Britain. For one thing, the country is very much smaller than the United States; and in the second place a much smaller proportion of the population is able to maintain an automobile, which is due to a somewhat lower standard of living, even where wages are good, and also to the greatly increased cost of maintaining a machine resulting from the higher cost of gasoline, oil, government taxes, etc. It is said that the number of automobiles licensed in New York City alone exceeds the total of all the British Isles; and the field occupied by the medium or low-priced car here, is taken care of there by the motorcycle with side car, which is the ordinary man's means of conveyance.

Competition with America

Automobile builders in England have been looking to an export trade as an outlet for the increased products of this "mass production." This offers no immediate prospect of success, however, owing to their inability to compete with American manufacturers, who are at a considerable advantage due to the greatly increased cost of material in England and to the fact that wages are, in many cases, now on a parity with those of America instead of being considerably below as in years past. This, added to the lower production capacity of the English workman, would seem to make competition hopeless for the near future, at least, in the markets of the world.

Market for High-grade Cars

There does, however, appear to be a fine field in both England and France for the manufacture of the luxury car, whether of the moderate grade or of the variety that can be purchased only by the very rich. It is evident that this industry is on a sound foundation, inasmuch as most of the factories building the finer class of car in a more or less old-fashioned way are still running, whether in England or France; some of them are operating at full capacity, while those who have tried to modernize their methods and build in large quantities are in some cases almost down and out. There is, furthermore, a possible field of export for these cars, not merely to other foreign markets, but to America as well. The ability and willingness to do the highest grade of body finishing and upholstering still survives in England to the extent that the stock cars of the best makers bear comparison with the finest product of the customs body builders in the United States.

Their market in the United States should still further improve in view of the continuous tendency in this country for the makers of the finest cars to expand their facilities more and more and put them on a manufacturing basis. While this tendency, if wisely carried out, will produce a car of the same excellence in large quantity, it does tend to eliminate the distinction of the better makes by making them more common, and a rich man is willing to pay for distinction; consequently there will probably always be a demand in this country for the high-priced foreign car made in smaller quantities and therefore necessarily by less efficient methods.

Points to be Studied in Producing High-grade Cars

In the future, it would seem that the great prizes in automobile production in England and France will go to the maker of the first-class car, who is willing to give careful study to the following points:

1. Making such changes in the design as will facilitate the manufacture of the car without affecting its quality in any degree whatever. A great improvement in this respect can be made in practically all high-grade cars.
2. Developing the ability to rough-machine the parts as rapidly as is done by the makers of the cheaper grades of car while maintaining the fine finish and fitting in the final operation. This is difficult but possible.
3. Making a study of the possibilities of machine-finishing of parts where hand work is now the rule. This applies to many surfaces where hand work is of no advantage but costs more and is only employed out of deference to the tradition as to the excellence of hand work in itself.
4. Making sure that the body work and upholstering in general is done as finely as at present, and that the finished car will suffer in no degree whatever from the improvements in design and manufacture mentioned.
5. Specializing on one design of chassis. The manufacturer who is willing to do this, can carry out all the previously mentioned points to a much more successful extent than the builder who carries two or three designs. It should be possible to specialize without injuring the quality of the product in any way.

In a word, all the conditions of manufacture for such things as automobiles are so different in Europe from those existing in America, that the rules for one region do not apply in the other. In America, the manufacturer who can build a car of fair quality in enormous quantity, has an opportunity to make engineering skill reap the highest reward. In Europe, the man who succeeds in solving the problem of design and manufacture for the very high grade car, made in moderate quantities, will be the one reaping the largest financial reward. Modern machinery and careful engineering study of the highest grades is required for both problems, but the solution will be quite different in the two cases.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Brown and Sharpe High-speed Milling Attachment

This attachment is intended for use on Brown & Sharpe milling machines, and it makes provision for increasing the speed of the milling cutter by means of a large gear mounted on the nose of the milling machine spindle, which meshes with a pinion on the special spindle. This attachment is made in two sizes, the larger one of which is furnished with adjustable gib stops that furnish means of mounting the attachment on machines with columns of different face widths.

A HIGH-SPEED milling attachment recently developed by the Brown & Sharpe Mfg. Co., Providence, R. I., for use on milling machines of its own manufacture is illustrated in Figs. 1 and 2. Reference to Fig. 2 will show that the increase in the speed of the milling cutter is obtained by means of a large ring gear which is placed on the nose of the regular spindle when the attachment is mounted on a machine; and this gear meshes with a pinion on the special spindle provided in the attachment. Two sizes of this attachment are manufactured, the No. 1 being intended for the smaller machines and the No. 2 for the larger. The latter size is adapted to columns of different face widths by means of adjustable gib stops, which eliminates the necessity of providing a separate attachment for each different size of column on the various machines in a shop.

A positive vertical position of the attachment is assured by the provision of a segment that rests upon the spindle box of the machine. This spindle box projects beyond the face of the column, and serves as a centering guide. The correct horizontal position is obtained by first tightening the gib on the right-hand side of the attachment, which effects the location. A gib on the left-hand side furnishes a means of securely clamping the attachment to the face of the column. This arrangement affords a large bearing surface and insures rigidity. The large ring gear previously mentioned has a tapered hole, ground to fit the nose on the machine spindle on which it is mounted. This gear is made of machine steel and is left soft to permit a smooth driving action and to avoid the chatter and noise often produced by the rotation of hardened gears at a high speed. On the No. 2 attachment, the pinion is heat-treated and keyed to the spindle, while on the No. 1 attachment, the teeth of the pinion are cut directly in the spindle.

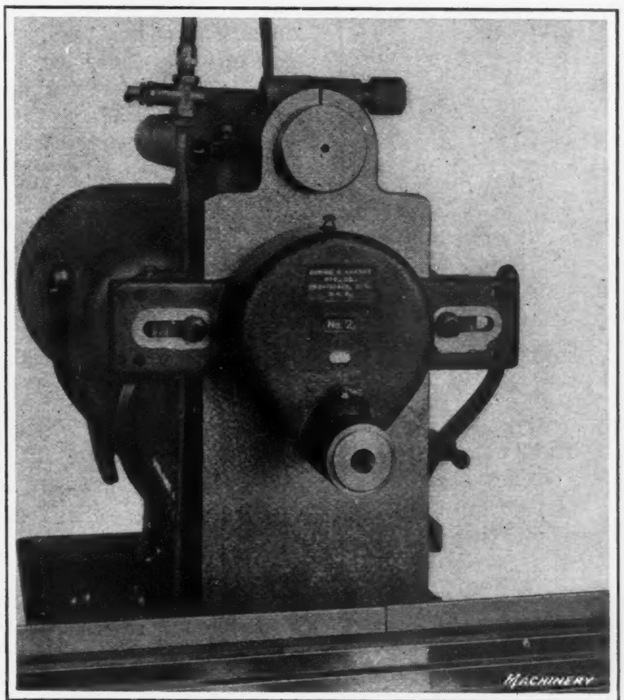


Fig. 1. High-speed Milling Attachment designed for Use on Machines built by the Brown & Sharpe Mfg. Co.

The spindle is hardened and ground, and it runs in a phosphor-bronze bearing, which is tapered to permit adjustment for wear. The adjustments are obtained by tightening a nut which causes the spindle to be drawn into the bearing. After an adjustment has been made on the spindle, the nut can be securely clamped by means of a small set-screw. End thrust of the spindle is taken up by hardened steel and babbitt washers mounted directly behind the shoulder on the front end. A No. 7 tapered hole is provided in the spindle on the smaller attachment for receiving the shanks of milling cutters, and a No. 9 tapered hole is furnished on the larger attachment. Oiling of the spindle bearing is secured by means of an oil

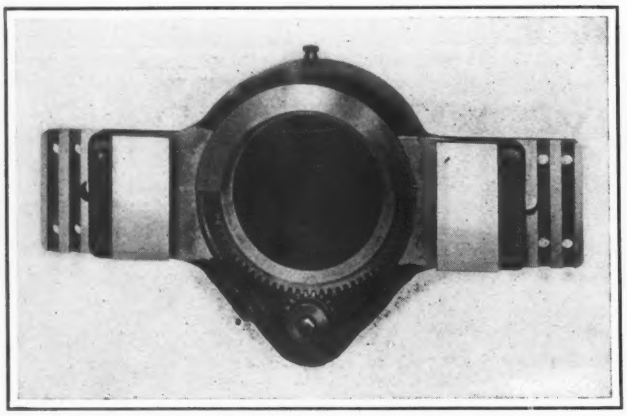


Fig. 2. Rear View of Milling Attachment, showing Adjustable Gibs and Method of driving Spindle

pocket on the front of the housing. Milling cutters are readily removed from the spindle by means of a releasing bolt, which positively causes their ejection.

HERCULES GEAR-HOBBING MACHINE

A gear-hobbing machine designed for the quantity production of spur, spiral, and worm gears at a low cost, and which is said to be particularly adapted to the manufacture of gears for automobile and tractor transmissions, change-gears, and gears entering into the drives of machine tools and other classes of machinery has been developed by the Hercules Machine & Tool Co., Inc., Broome and Lafayette Sts., New York City. The main feature of this machine is a differential mechanism that greatly simplifies the calculations necessary to determine the change-gears required in hobbing spiral gears. On account of this differential, no calculations are involved when changing the rate at which the hob is fed, or from a right- to a left-hand gear, provided the angle and pitch of the teeth remain the same. Another feature which the makers claim is not furnished on any other gear-hobbing machine, is a rapid traverse of the cutter-slide up or down on the column.

Feed and Rapid Traverse of the Cutter-slide

Reference to Fig. 1 will show that the machine is equipped with a single-pulley drive that is connected to the machine

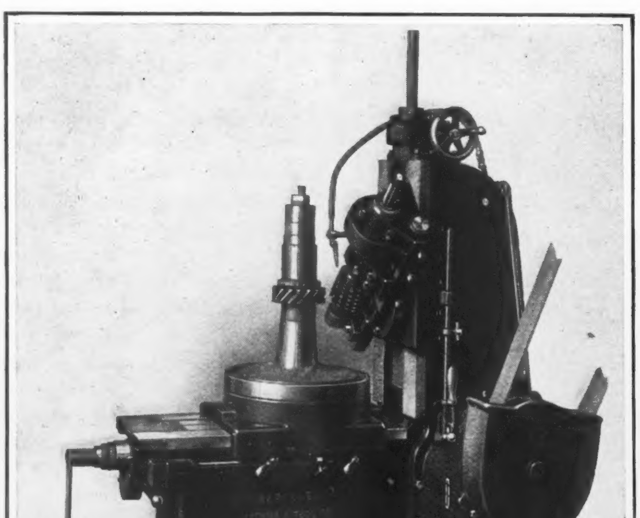


Fig. 1. Hercules Gear-hobber provided with Differential that simplifies Spiral Gear Hobbing

through a gear-box permitting nine different speeds, any of which may be secured by operating one of two handles at the rear of the box. The cutter-slide is moved vertically by means of a feed-screw that engages with a nut held in a casting attached to the top of the column. When this nut is revolved, the cutter-slide is either raised or lowered, the movement depending upon the direction in which the nut is rotated. The rate at which this nut revolves, and therefore the feed of the cutter-slide, is governed by the gear-box *A*, Fig. 2, to which the nut is connected by means of shaft *B* and suitable gearing. The gear-box furnishes eight feeds for the cutter-slide, four of which are obtained by moving handle *C* to various positions when lever *D* is placed in one of its two positions, the other four feeds being also secured by moving handle *C* when lever *D* has been placed in its other position. Three locking positions are also provided for lever *E;* when it is in the central position, the feeding mech-

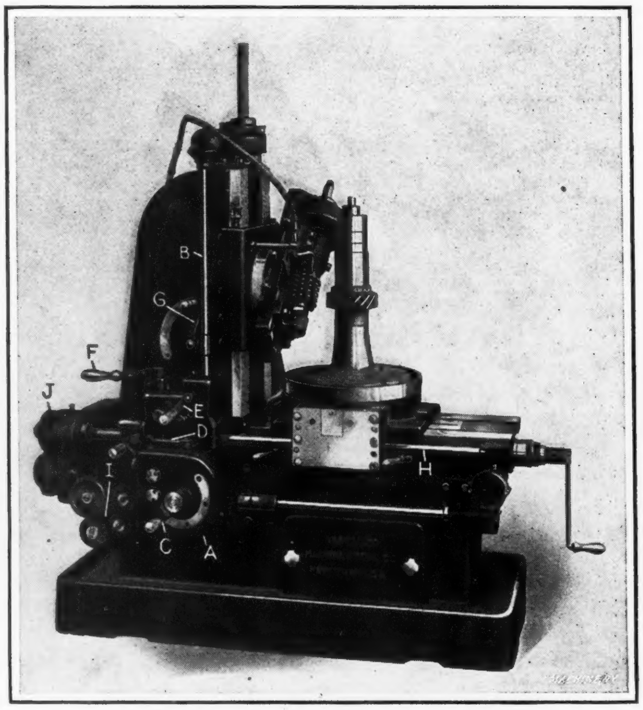


Fig. 2. Left Side of Gear-hobber, showing Gear-box controlling Feed of Cutter-slide

anism is in neutral, and when it is in the upper position the mechanism is connected for feeding the hob to the work. By placing the lever at the low stop and pulling lever *F* away from the machine, the rapid traverse of the cutter-slide in a downward direction is obtained. By pushing lever *F* toward the machine, the cutter-slide is traversed upward at a fast rate of speed. The cutter-slide may also be raised or lowered by hand, by revolving the handwheel at the top of the column, which can clearly be seen in Fig. 1.

Setting the Hob and Obtaining its Rotation

The cutter-spindle is mounted on a swivel head bolted to the cutter-slide. This head permits the teeth of the hob to be set at the proper angle in relation to the blank to be cut, a circular surface on the cutter-slide being graduated in degrees to facilitate the setting. Adjustment of the hob axially is also provided, and a centering device is furnished for determining when the center of a tooth on the hob has been placed in alignment with the center line of the work-arbor. The rotation of the hob is obtained by means of a vertical driving shaft connected to the cutter-spindle through a set of bevel gears and two sets of spiral gears. By employing spiral gearing, the cutter-spindle is brought close to the column, thus permitting greater rigidity of the unit, producing a smooth running action, and eliminating chatter.

The direction of rotation of the hob to suit the cutting of right- and left-hand spiral gears is obtained by locating lever *G* in one of its two working positions. A tripping mechan-

ism is provided at the right-hand side of the cutter-slide to disengage the driving clutch in the speed gear-box when the cutter-slide has been lowered to a predetermined position. In this way, not only is the feed of the machine stopped, but all other moving parts as well, except of course, the driving pulley.

Work-holding Fixture and Table

The rotation of the work-holding fixture on the table is obtained by means of gearing that connects it to the shaft *H* running along the left side of the bed, the proper ratio between the feeding movement of the hob and the rotation of the work being secured by means of the indexing change-gears *J* at the rear of the machine. These change-gears are driven through the differential mechanism previously mentioned, and a sufficient number is furnished to permit the hobbing of spur, spiral, and worm gears up to 360 teeth. Gears *I* are change-gears for the differential mechanism, and are chosen to suit the angle of spiral gear teeth.

The table is moved toward the column until the hob is cutting to the desired depth by means of a feed-screw provided with a dial graduated in thousandths of an inch. Arrangements are made to feed the table automatically when worm-wheels are being hobbed. The work-holding arbor is prevented from springing during an operation on large gears by an upright support which is not shown on the machine, but which is mounted on the bed and connected to the arbor at its upper end, so that it slides along the bed with the arbor. The height of the supporting member on this attachment can be adjusted vertically to suit the work.

A self-contained lubricating system supplies cutting oil to the hob, and the gears in both gear-boxes run in oil. The machine has a capacity for cutting steel gears up to 4 diametral pitch, 29 inches outside diameter, and 12 inches face width. The minimum distance from the center of the work-arbor to the center of the cutter-spindle is 1½ inches; the diameter and face width of the clutch pulleys on the counter-shaft, 12 and 4 inches, respectively; the speed of the driving pulley, 360 revolutions per minute; and the weight of the machine, approximately 4000 pounds.

LEHMANN GEARED-HEAD ENGINE LATHE

A type of geared-head engine lathe giving sixteen spindle speeds, and which is built in a number of sizes, is shown in Figs. 1 and 2. This lathe is the product of the Lehmann Machine Co., Chouteau Ave. at Grand Ave., St. Louis, Mo. The spindle speeds on the 16-inch machine cover a range of from 10.5 to 422 revolutions per minute in geometrical progression, while those on the 22-inch machine range from 8.5 to 330 revolutions per minute. Various speeds are obtained by shifting levers on the front of the gear-box.

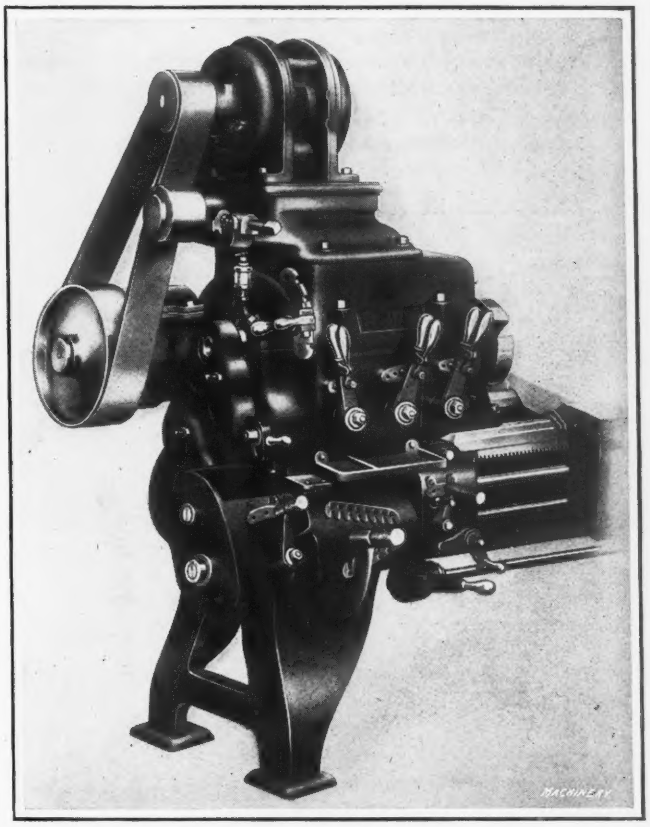


Fig. 2. Headstock End of Lathe showing One Arrangement of Direct Motor Drive

Owing to the gear ratio, which is 57.1 to 1 on the 16-inch lathe and 70.6 to 1 on the 22-inch machine, the driving shaft can be operated at a high rate of speed and the position of the shaft permits the use of a driving pulley of large diameter. The usual arrangement for a direct drive is to mount the motor on the headstock, as shown in Fig. 2, driving through a short belt running over an idler pulley. Ball bearings are provided for the idler pulley, and it has ample adjustment. It is stated that with the fast belt travel employed on these lathes, this arrangement is a satisfactory application and no trouble is experienced on account of the short belt, the pull on the belt being much less than usual on account of the large diameter and high speed of the driving pulley. The construction of the geared head is such that no interlocking device is needed to prevent the engagement of two different gear ratios at one time. All gears in the headstock are made of heat-treated steel.

The motor runs at the rate of 1800 revolutions per minute. Suitable guards are provided for the belt and pulley. A direct drive can also be furnished with the motor mounted on a base hinged to the rear leg at the headstock end of the lathe. No idler pulley is required in such an application. The spindle is made of an alloy steel, and its bearing surfaces are hardened and ground. Four keys are milled integral with the spindle to suit the sliding back-gear clutch. Two surfaces of different diameters are provided on the spindle nose to furnish bearings for faceplates, one bearing surface being in front of the threads on the nose, and the other being in back of them. This design permits the faceplates to be rigid on the spindle and facilitates their mounting and removal.

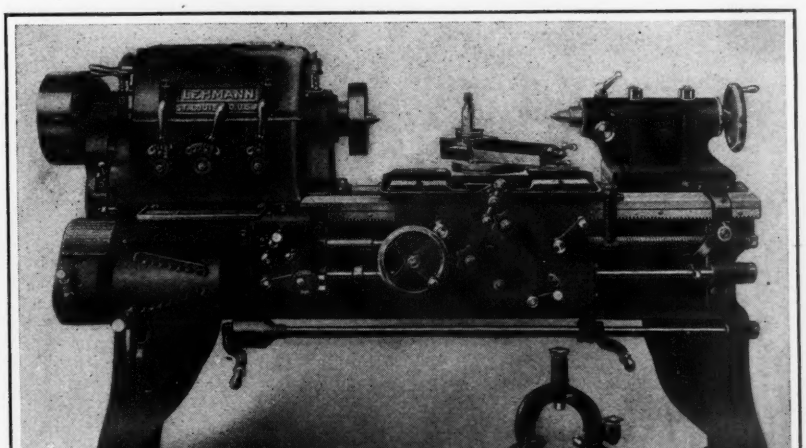
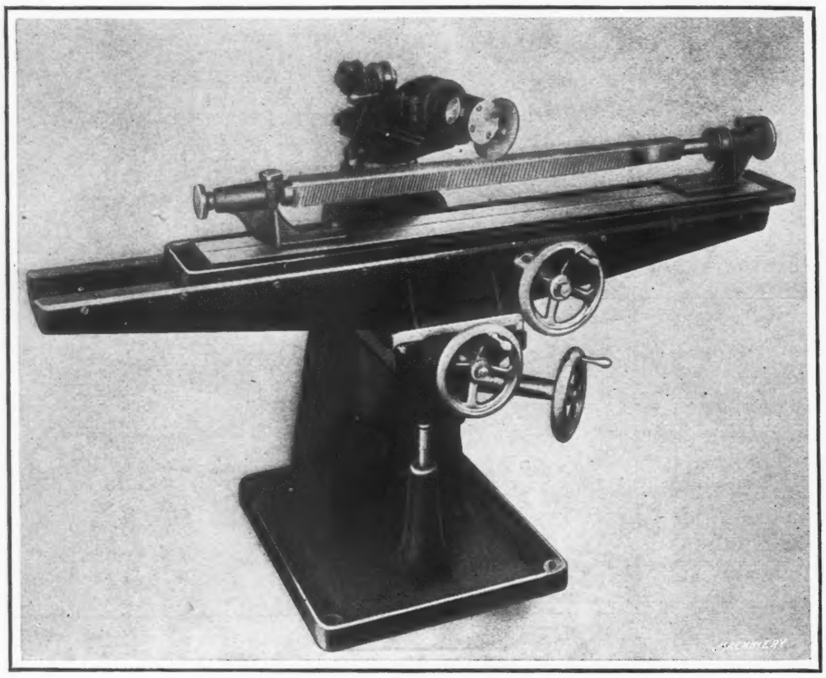


Fig. 1. Geared-head Engine Lathe built by the Lehmann Machine Co., which has Sixteen Spindle Speeds

J. N. LAPOINTE BROACH GRINDER

A single-purpose grinding machine designed for the sharpening of broach teeth has been recently placed on the market by the J. N. Lapointe Co., New London, Conn. This machine is a refinement of one used similarly for a number of years in the shops of this company, and it has been placed on sale



Grinding Machine built by the J. N. Lapointe Co. for grinding the Rake and Face of Broach Teeth

to meet the demand for a tool-room machine capable of accurately and rapidly grinding the rake and face of all types of broach teeth. The machine is of the adjustable knee type, is ruggedly constructed, and will support broaches up to 64 inches in length, by 8 inches in diameter. Round broaches may be swung between centers furnished with the machine, and square broaches or keyway cutter-bars may be clamped to the table.

The live center is driven by a belt from an auxiliary countershaft and may be operated at three different speeds. A simple indexing mechanism contained in the headstock unit adapts the machine for the accurate grinding of spline and internal gear broaches. The grinding wheel is mounted on a spindle supported by a swivel head, motion being transmitted to the spindle by a belt from the main countershaft. A pair of idler pulleys guides the belt to suit the various angles at which the spindle and its abrasive wheel may be swung. The swivel head pivots on the column of the machine, and may be swung to any angle in the horizontal plane so as to permit the grinding of broach teeth which are not machined at the customary right angle to the work axis. The entire swivel-head unit is moved forward to bring the grinding wheel in contact with the work by means of a hand-lever located in a convenient position for the operator. The over-all dimensions of the machine when the table is extended, are as follows: Length, 11 feet 2 inches; width, 3 feet 3 inches; and height, 3 feet 11 inches.

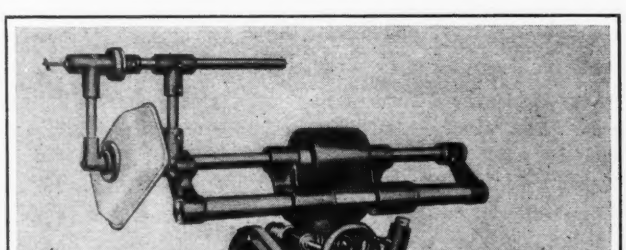
CONTOUR BUFFING MACHINE

A machine designed for automatically feeding work of oval, rectangular, or triangular contour, as well as that of circular form, against the wheels employed on polishing or buffing lathes, has been developed by the Contour Buffing Machine Co., Inc., 410 Bird Ave., Buffalo, N. Y. By reference to the illustration, it will be seen that the machine is self-contained, being driven by an electric motor attached to the bedplate. This bedplate rests on slide-rails, permitting an adjustable travel of 8 inches to or from the polishing wheel, to suit work of different diameters and various sizes of polishing wheels. The work-spindle is rotated slowly, and it is supported in a sliding frame having a reciprocating motion that is adjustable from zero to sixteen inches.

The work-spindle and the sliding frame are driven by gears on a vertical shaft in the column, the latter being supported on trunnions located on the bedplate, and thus it is free to oscillate through about 10 degrees. When the article being polished is of a special contour, this oscillating movement is controlled by a cam which corresponds to the contour of the work. The position of the guiding roller used in connection with this cam may be adjusted through a slide actuated by a handwheel, and the roller is controlled by an adjustable spring in the slide. When the article being polished is of circular form, a cam is not required and a link is substituted for the purpose of holding the column stationary in a vertical position.

The upper part of the column and the sliding frame are arranged to be swiveled by means of worm-gearing operated by a handwheel. By this arrangement, the operator may swing the work to or from the buffing wheel without stopping the machine. The article being polished is held on the chuck by the work-holder as illustrated, the outer arm, which is provided with a free-running wooden washer which it holds against the work, being pulled hard toward the right by means of an adjustable tension spring inside the pipe at the top of the work-holder. The outer arm is held by stops in the position shown, but it can be swung through a half circle until it again engages the stops and be held in that position to facilitate the removal of the work and the substitution of an unpolished piece.

A variable angle attachment can be readily fastened to



Machine developed by the Contour Buffing Machine Co., Inc., for polishing Parts of Circular, Oval, Rectangular, or Triangular Contour, etc.

the sliding frame to accomplish the polishing of conical articles and the bottoms of pans, etc. This device permits the work to be set at any point in a horizontal plane within an

arc of 90 degrees. The direction of the motor-shaft rotation is reversible; and these machines are made in right- and left-hand models so that two of them can be run in conjunction with one polishing lathe, and by one operator. It is claimed that in this way an important saving of labor is effected. Various modifications of this machine can be furnished to suit requirements; if the articles to be polished are all of circular form, the cam mechanism can be dispensed with, and, for many classes of work, the mechanically operated reciprocating motion is unnecessary, as the sliding frame can be moved to any desired position by hand and locked in place.

MEREY ROTARY EMBOSSING MACHINE

The rotary embossing machine shown in Figs. 1 and 2 is a recently patented invention of Julius Merey, 2842 N. Maplewood Ave., Chicago, Ill. This machine was designed to emboss inscriptions on tubular objects, such as ice-cream cans, milk cans, and similar containers, as well as flat objects. One of the advantages of the rotary type of embossing machine is that it permits the manufacturer to make up a quantity of milk cans or other standard tubular products and then emboss the inscriptions required by the purchaser when his order is received. This feature makes it possible to fill orders quickly and also enables the manufacturer to maintain a more uniform production rate.

Referring to Fig. 1, it will be seen that the main frame is of heavy cast-iron construction. Four boxes provided with phosphor-bronze bushings are located in the cast-iron housing at the left-hand end of the machine. The two lower boxes are stationary, while the upper ones are adjustable vertically. The two adjustable boxes carry the shafts on which the embossing dies are mounted. These two shafts are each two feet long; they have bearing diameters of 3¾ inches, and are hardened and ground all over. The machines are equipped for belt drive, a 16- by 4½-inch pulley provided with a positive clutch being located at the back of the machine as shown in Fig. 2. At the opposite end of this shaft there is a bevel pinion which meshes with a bevel gear attached to a vertical shaft. The vertical shaft transmits power to the shafts on which the embossing dies are carried by means of worm-gearing.

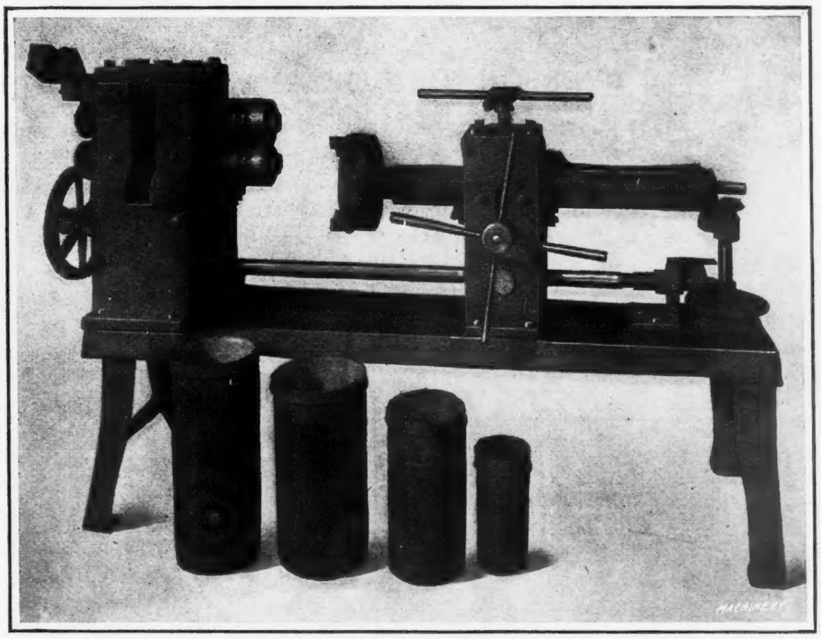


Fig. 1. Rotary Type of Embossing Machine developed by Julius Merey

The vertical shaft is made in two pieces; the lower section having a right-hand worm is rotated in a stationary position and drives the lower worm-gear, while the upper section having a left-hand worm rotates in a stationary position until forced to move upward with the upper worm-wheel to permit the work to be placed between the embossing dies. The upper section of the vertical shaft slides in the lower one and is provided with two accurately fitted keys in order to maintain proper alignment of the embossing dies and to insure adequate driving power. The upward movement of the shaft,

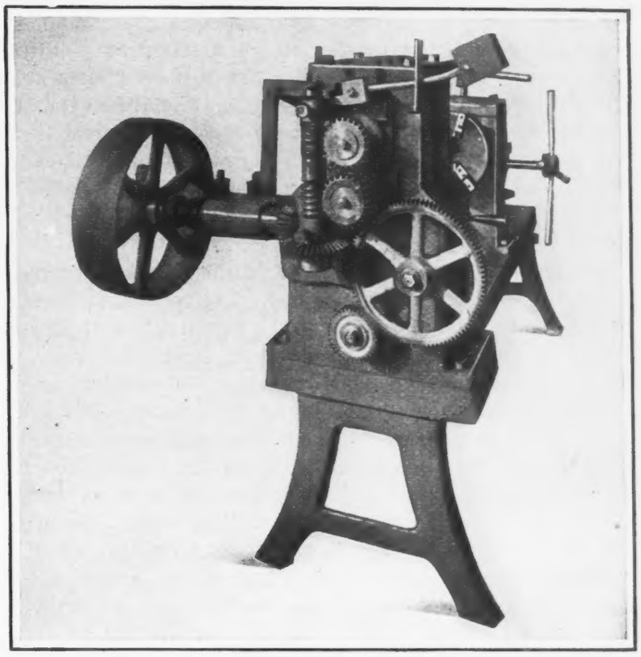


Fig. 2. End View of Merey Embossing Machine shown in Fig. 1

which permits the work to be entered between the embossing dies, is obtained by means of a cam. This upward movement is approximately ⅜ inch and takes place after the embossing operation has been completed. A locking device is provided which permits the upper shaft to be held down in the proper position while the embossing operation is taking place. An automatic stop is also provided for stopping the machine when the operation is completed.

The male and female embossing dies are made in segments which are interchangeable, thus providing means for setting up the machine to emboss any name or inscription that is desired. The upright frame at the right-hand end of the machine, Fig. 1, supports a shaft on which the work-holding chuck is mounted. Longitudinal and vertical movement of this shaft is provided to accommodate work of various sizes. The shaft on which the chuck is carried is driven by means of spur gears. At the end of the driving shaft is an adjustable friction plate which permits objects having steps of different diameters to follow the arcs of the embossing-die segments. This machine weighs approximately 2000 pounds and has a capacity for embossing three-row inscriptions at the same time on 16-gage steel. Only 3 horsepower is required to drive the machine.

BRIDGEPORT FACE GRINDER

A motor-driven horizontal face or edge grinding machine having a capacity for handling work up to 24 feet in length, which has recently been developed by the Bridgeport Safety Emery Wheel Co., 83 Knowlton St., Bridgeport, Conn., is illustrated in Figs. 1 and 2. This machine was designed for bolting to a solid foundation; it is provided with a stationary work-holding table, the grinding wheel being mounted on a

column bolted to a short carriage that is traversed along flat top rails of the bed in back of the table. The traversing movements in either longitudinal direction are obtained by means of a 5-inch diameter lead-screw running the entire length of the bed between the surfaces on which the carriage is supported. This lead-screw is driven by a 7½-horsepower motor operating at 1150 revolutions per minute, the motor being connected to the screw by means of a silent chain and reduction gearing. A toothed clutch operated by a shifting lever serves to place the proper gears in mesh for revolving the lead-screw in the desired direction. Radial ball bearings are provided at both ends of the lead-screw and end thrust ball bearings on each side of the journal at the right end of the screw, adjustments being furnished to compensate for any slight wear. Several supports are provided for the lead-screw between the end bearings.

One side of the column has two finished flat surfaces upon which the wheel saddle is mounted. The vertical movements of the saddle, and therefore of the grinding wheel, are obtained by means of a 2-inch elevating screw that is driven by a 3½-horsepower motor running at 850 revolutions per minute which is mounted on top of the column. The motor is connected to the screw through spur and worm reduction gears, which permit a practical speed for the screw. The necessary gears to move the wheel up or down as desired are thrown in mesh by means of a shifting lever. The grinding wheel is made up of sectional blocks forming a wheel 32 inches in diameter with a face 8 inches wide and a cutting rim 4 inches thick, there being fourteen sections with an open space between each one to cause the chips to be removed from the face of the wheel.

The wheel-spindle is driven by a 40-horsepower motor running at the rate of 1150 revolutions per minute, to which it is connected by a fiber pinion and a large gear, the ratio between the two being about 2 to 1. Both the grinding-wheel spindle and the motor are mounted on a head that is attached to the saddle previously mentioned. Transverse movements of the wheel can be obtained by operating the head on the saddle by means of a 1½-inch diameter screw that is turned through the use of a 14-inch diameter handwheel at the rear of the machine. The wheel-head can be swiveled to permit the work to be ground at an angle as well as perpendicularly. The wheel-spindle runs in ball bearings and is provided with end-thrust bearings to take up the thrust in either direction, adjustments being furnished for wear.

Automatic reversal of the traverse of the column is obtained by means of a stop on the front of the column near the bottom, which comes in contact with dogs mounted on a shipping bar extending the full length of the bed. This shipping bar is supported at five points and two dogs are furnished between each support, the dogs being pivoted so that they can be readily moved out of the way and only two of them used as required to cover the range of travel desired. The table previously referred to has a working face 18 inches wide and has two T-slots running its entire length. The work must be firmly mounted on this bed in such a manner that the face to be ground will come in contact with the grinding wheel. If the work is of such width that it extends back from the table to any great extent, it should be supported by suitable horses. A full-length supplementary table 10 inches wide is provided to be attached to the work-table when small pieces or sheet stock are to be ground. The weight of the machine, ready for domestic shipment, is approximately 32,000 pounds.

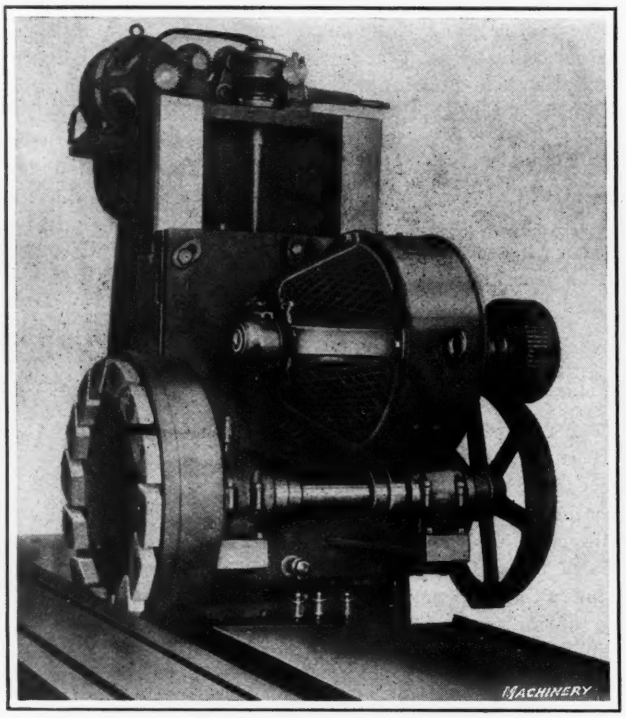


Fig. 2. Close-up View of Grinding Wheel and Motor, showing Method of mounting on Column

RYERSON HIGH-SPEED FRICTION SAWS

A line of high-speed friction saws, designed for the rapid cutting of structural steel, has been developed by Joseph T. Ryerson & Son, Sixteenth and Rockwell Sts., Chicago, Ill., one of which is shown in the illustration accompanying this description. The base of the machine is made of cast iron and is of a heavy box section. It supports a carriage on which there is mounted the motor furnishing power for rotating the saw disk. This carriage runs on large rollers, equipped with ball bearings, the rollers being mounted on eccentric shafts furnishing adjustment for wear. The saw disk or blade is directly mounted on the armature shaft of the motor, the blade being made of a special grade of soft steel, balanced, hollow-ground and nicked on the edge to increase the friction between the saw and the work. The saw is held in place by two heavy cast-steel collars, and the cutting edges are cooled by jets of water directed against it. A hood bolted to the carriage serves as a guard for the saw; this hood can be opened to facilitate examination or removal of the saw.

Movement of the carriage is accomplished either by hand or power, the power feed being obtained through the em-

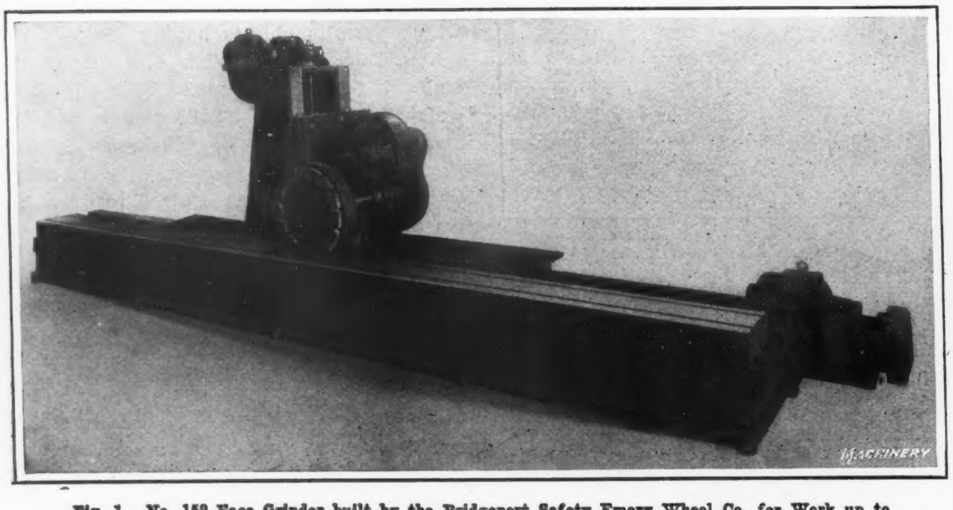
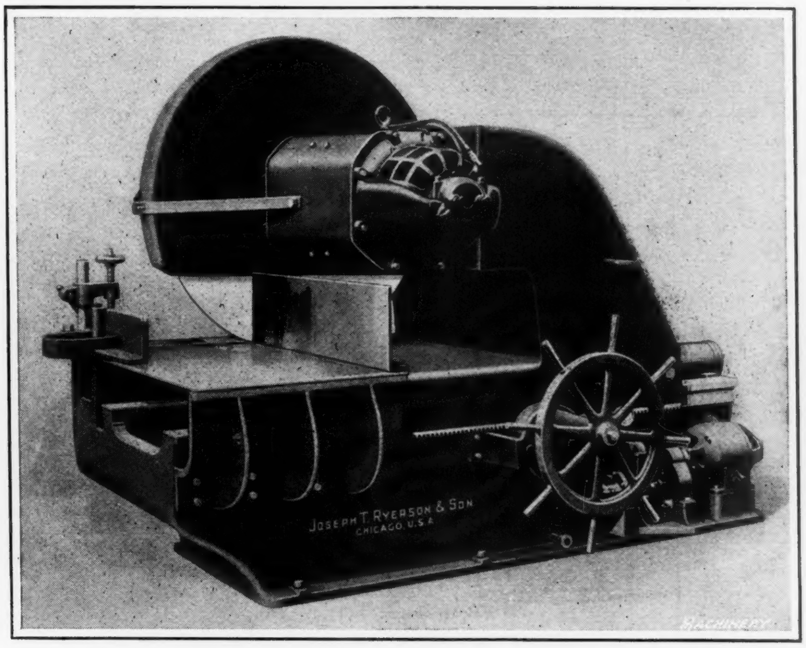


Fig. 1. No. 152 Face Grinder built by the Bridgeport Safety Emery Wheel Co. for Work up to 24 Feet in Length



Hand- and Power-feed Friction Saw developed by Joseph T. Ryerson & Son

ployment of a special electro-hydraulic arrangement which consists of a cylinder connected to the base of the machine, a piston attached to the under side of the carriage, a one-horsepower motor which drives a geared pump, a suitable tank, and pressure relief and four-way controlling valves. The four-way valve may be placed in any convenient position and affords the operator complete control of the movements of the carriage.

The cutting speed is regulated by adjusting the pressure of the saw against the material, but the speed should not be so great as to overload the saw motor. To guard against this, the relief valve is placed in the feed line leading to the cylinder, and set to operate at a pressure corresponding to the maximum ampere load of the saw motor. This arrangement also insures the working of the saw to its full capacity when cutting through materials with varying cross-sections, such as rails, beams, angles, etc.

Various sizes and shapes of material can be cut in immediate succession without any adjustment of the machine, it being unnecessary to clamp the material. Miter cutting, as well as straight cutting, is easily handled by means of a graduated swivel clamp supplied as part of the machine. The machine is made in four sizes, Nos. 1, 2, 3, and 4, which can be furnished for any current or voltage. The No. 1 machine has a capacity for cutting standard I-beams up to 12 inches, 40-pounds; channels up to 12 inches, 40 pounds; angles up to 8 by 8 by 1/2 inch; standard rails up to 50 pounds; and bars up to 1 1/2 inches square and 2 inches in diameter. The diameter of the saw blade is 46 inches, and the weight of the machine provided with power feed is about 5740 pounds. The capacity of the No. 4 machine is for standard I-beams up to 24 inches, 100 pounds; maximum sizes of channels, angles, etc., and bars up to 3 inches square and 3 1/2 inches in diameter. The saw blade on this machine is 56 inches in diameter, and the weight of the machine is approximately 12,650 pounds.

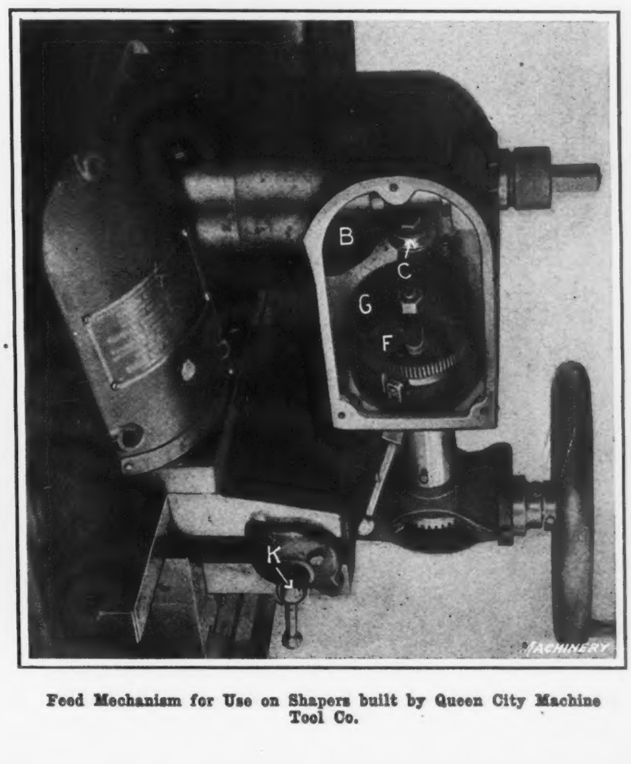
FEEDING DEVICE FOR QUEEN CITY SHAPERS

The feeding device shown in the accompanying illustration was recently brought out by the Queen City Machine Tool Co., 1405 Sycamore St., Cincinnati, Ohio, for use on this company's line of shapers. This device consists of two units, one of which is attached at the bull-wheel bearing and the other at the end of the rail feed-screw. The unit attached to the bull-wheel bearing controls the amount of feed for each stroke of the ram, while the unit attached to the rail feed-screw controls the direction of feed. At the end of the bull-wheel hub is attached a face-cam *B*, which actuates roller *C* mounted on a swinging arm, at one end of which is a ratchet pawl which engages ratchet wheel *F*.

The ratchet wheel is unusually large and drives the splined feed-shaft sleeve through the medium of a safety friction device. This arrangement prevents the machine from being damaged in case the table is fed to the limit of its traverse, or in case the feed is obstructed by interference with the work or by a wrench accidentally dropped where it will prevent the proper functioning of the mechanism. A powerful spider spring *G* provides a driving pressure which is ample for all needs and automatically compensates for wear. However, if it is desired to change the pressure at any time, it can easily be accomplished by adjusting the nut on the top of the spring.

The swinging arm on which the cam-roll *C* is mounted has a large bearing which fits over the outside of a sleeve that is pressed into the housing. The double splined feed-shaft sleeve is, in turn, fitted inside the sleeve that is held in the housing. The swinging arm is held in contact with the cam by means of a long torsion spring. The amount of feed is controlled by a stop on the adjusting-handle extension, which limits the swing of the roller arm. When the feed-controlling lever is placed at the zero position, the actuating members remain motionless. Sixteen changes of feed are provided for the movement of the parts. The feed can be started, stopped, or reversed by operating lever *K*.

The gear-box contains the familiar bevel gear and clutch construction, the clutch teeth being integral with the gears. Provision is made for adjusting the mesh of the gears to compensate for wear. A partition is placed back of the cam, and felt oil-retaining rings and wipers are employed so that the gears can be run in oil. The sliding connection to the rail is rigidly supported by a long sleeve. The driving keys and the shaft are made unusually long, and the position of the shaft is such that it prevents the parts from being forced out of alignment. All parts of the device are interchangeable, and it is stated that it can be easily disassembled and completely reassembled in less than fifteen minutes.

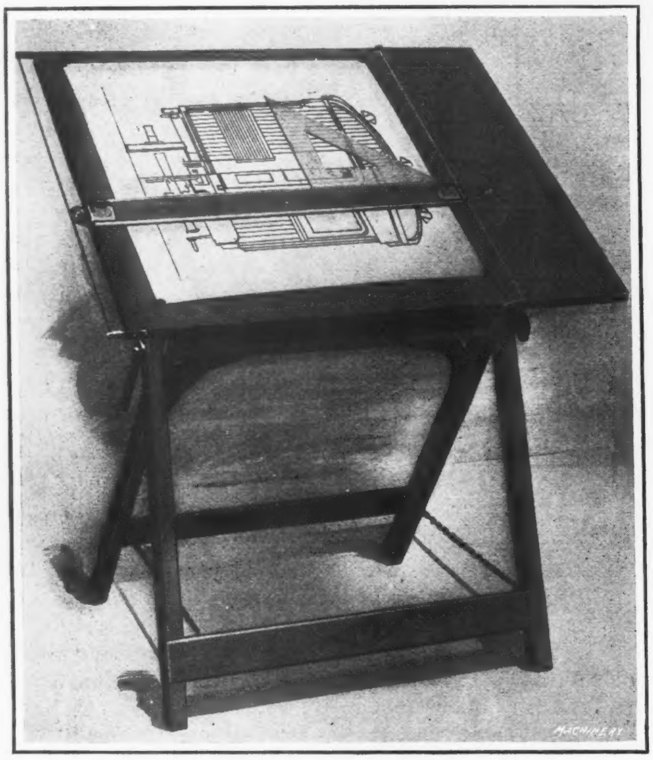


Feed Mechanism for Use on Shapers built by Queen City Machine Tool Co.

PARALLEL RULING ATTACHMENT

The parallel ruling attachment shown mounted on a drawing board in the illustration has been placed on the market by the New York Blue Print Paper Co., 102 Reade St., New York City. This attachment consists of the following metal parts which are made of aluminum to eliminate corrosion: one plate with a double pulley, one plate with two small pulleys, and four metal brackets with a hole at each end and a small metal grip to hold the cord firmly. Sufficient silk cord is also supplied for arranging the attachment on a drawing-board. A shoulder on the double-pulley bracket slides along one edge of the drawing-board and thus serves the same purpose as the head of a T-square. The parallel cords running across the drawing-board are hidden in the straightedge. The latter can be held at an angle for the purpose of drawing slanting lines.

The attachment is so made that it is easy to mount on a drawing-board, and it may be supplied with crystalloid trans-



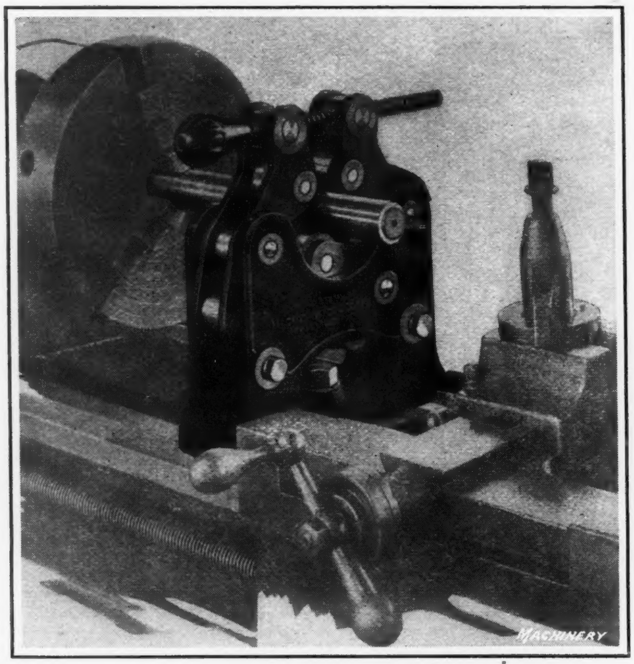
Drawing-board equipped with Parallel Ruling Attachment made by the New York Blue Print Paper Co.

parent-line straightedges, mahogany ebony-line straightedges or hardwood-line straightedges. Various lengths ranging from 24 to 60 inches may be furnished. Anyone possessing a good straightedge not less than 1/8 inch thick, can have the necessary metal parts of the attachment mounted on it by sending it to the concern mentioned.

MC CROSKY SELF-CENTERING STEADYREST

A quick-acting and self-centering steadyrest designed for use on lathes and grinding machines, and especially adapted to the holding of work, on the ends of which facing, boring, turning, and similar operations are to be performed, has been developed by the McCrosky Tool Corporation, Meadville, Pa. Reference to the illustration will show that the work is supported by three rollers, two of which are mounted on pivoted brackets, the third being arranged to support the work at the bottom. These three rollers are adjusted simultaneously to suit the diameter of the work.

The rollers on the regular steadyrest are hardened and rotate on roller bearings; however, if soft and highly finished work is to be handled, hardened rollers are not recom-

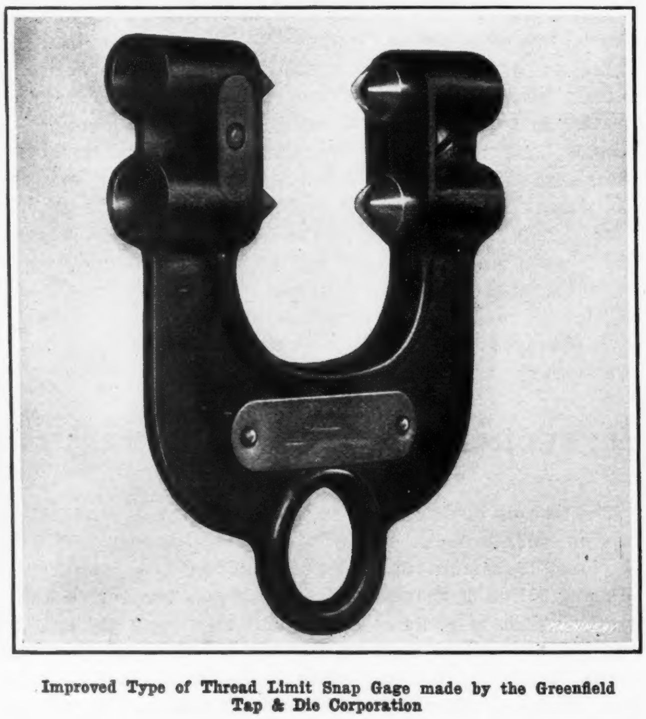


Lathe and Grinding Machine Steadyrest made by the McCrosky Tool Corporation

mended, stationary cast-iron jaws being supplied instead. It is claimed that the steadyrest is equally suitable for a variety of general work and for quantity production. When it has been once adjusted to the centers of the machine, the steadyrest can be taken off frequently and replaced in a few moments without readjustment.

G T D THREAD LIMIT SNAP GAGE

An improvement has been made on the thread limit snap gages manufactured by the Greenfield Tap & Die Corporation, Greenfield, Mass., so that the two "Go" or "Not Go" anvils of a gage are placed directly opposite each other, instead of having them offset an amount equal to one-half the pitch of the screw thread, the latter construction being necessary on the old type of gage on account of the complete use of solid conical measuring points. With the new type, however, one of the anvil points is solid as before, but the opposite one is of a much larger diameter and is provided with

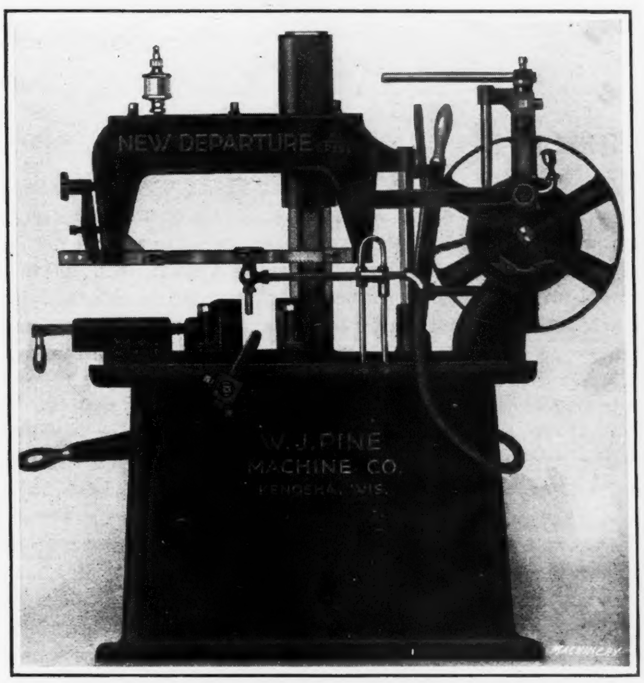


Improved Type of Thread Limit Snap Gage made by the Greenfield Tap & Die Corporation

a V-shaped groove running across the center. This groove is of sufficent depth to clear the thread diametrically across the screw from the first anvil, the measurement of the thread being accomplished by having the conical surface of the second anvil in contact with the thread flanks, instead of the V-groove surfaces. When testing the pitch diameter of a screw, the work is simply passed between the "Go" anvils of the gage, but it must not be possible to pass it through the "Not Go" anvils.

W. J. PINE METAL SAW

The metal saw illustrated is known as the "New Departure," and was designed by the W. J. Pine Machine Co., 411 Jenne St., Kenosha, Wis., to more economically and rapidly perform such operations as cutting out machine parts of various irregular shapes, which are frequently machined on shapers and milling machines. In work of this kind, a certain amount of stock is usually lost when the operation is performed on other machines, but by the use of this saw it can be saved for future use. The depth of a cut can be regulated by means of a graduated indicator, and the work may be clamped accurately in the vise at any desired angle,



Hacksaw Machine manufactured by the W. J. Pine Machine Co.

the correct setting being obtained by means of a graduated adjusting device. Auxiliary vise jaws which can quickly be put in place or removed from the machine are provided for holding irregular work. On the return stroke of the saw blade, it is lifted from contact with the work by a positive movement which is not dependent upon a spring. Because of this arrangement, the saw cannot be dragged, and danger of injury to it from such a cause is eliminated.

KANE & ROACH STRAIGHTENING MACHINES

The No. A straightening machine shown in Fig. 1 is a recent product of Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y. This machine is designed especially for straightening sheet steel blanks for hacksaw blades, files, knives, and similar work which requires straightening while cold, both before and after tempering. One of the notable features of this machine is the employment of stepped rolls for the purpose of overcoming the difficulties experienced in straightening blanks which vary in thickness, amount of curvature, and hardness.

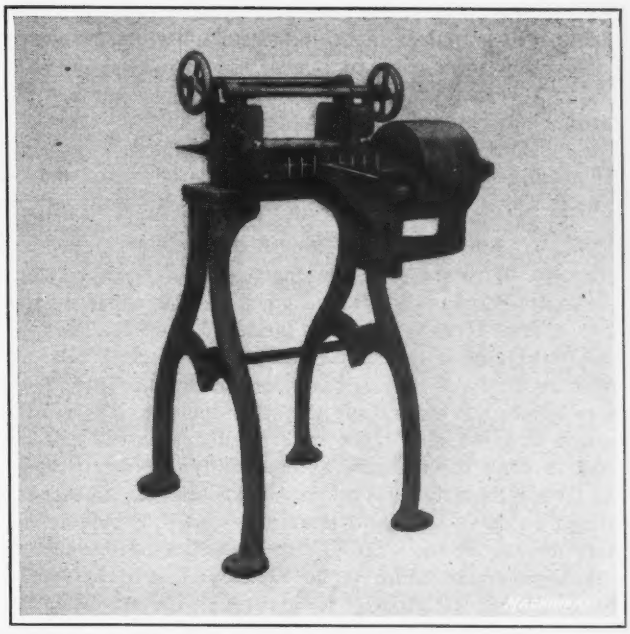


Fig. 1. Kane & Roach No. A Straightening Machine

The straightening is accomplished by passing the work between two pairs of rolls which are gear driven, as will be observed by referring to Fig. 1. The two upper rolls are adjustable vertically, while the two lower rolls are mounted in stationary bearings. The function of the first or front upper roll is that of taking out kinks and bends while the last or back upper roll completes the final straightening operation. There are seven steps on each roll, the diameter of the first step at the right-hand end of each roll being the smallest. The diameter of each succeeding step to the left of the small step is greater than that of the step which precedes it. Therefore, this construction gives seven steps each of a different size.

When the machine is set up for any particular size or thickness, it is usually adjusted so that the middle step will properly straighten the average blank. This leaves three smaller steps at the right of the middle step and three larger steps at the left. There is a guide or pocket leading into each of these different steps which will not allow the material to start at an angle with the rolls or allow it to run off the step.

When an experienced operator picks up a piece, he can tell almost instantly into which step it should be placed.

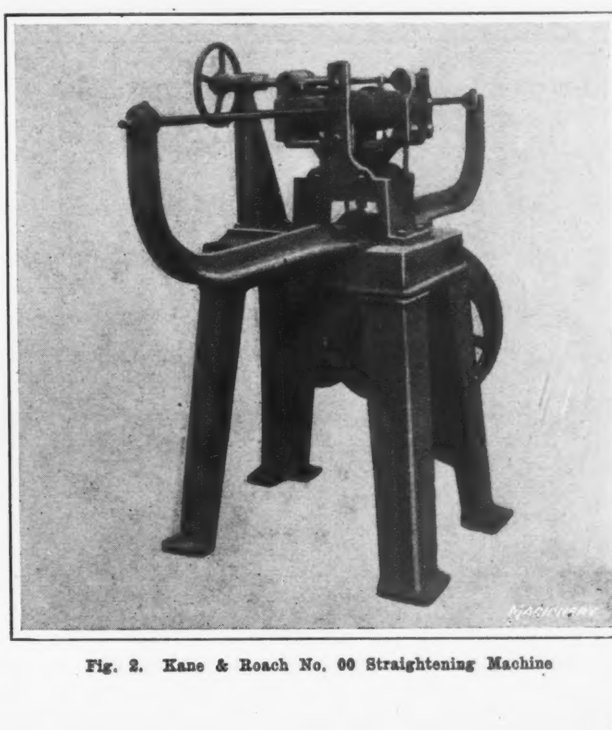


Fig. 2. Kane & Roach No. 00 Straightening Machine

If the piece is of average thickness, curvature, and hardness, it will be placed in the middle step, while if it varies considerably from the average it will be placed on either a larger or smaller step according to its condition. This machine can be used for straightening blanks as short as 3 or 3½ inches and from that size up to almost any length. The machine occupies a floor space 24 by 36 inches and can be driven by a ½-horsepower motor.

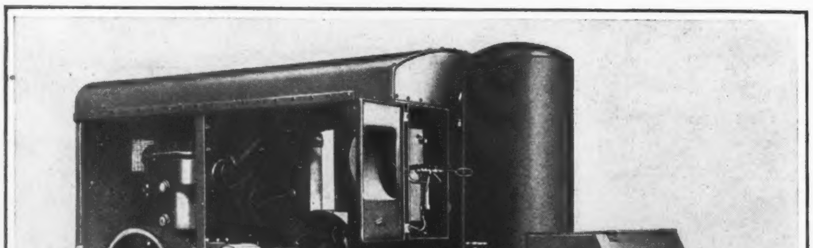
No. 00 Rotary Straightening Machine

The No. 00 rotary straightening machine shown in Fig. 2 is intended for handling round stock (either tubes or solid bars) in sizes from 3/32 to 5/16 inch in diameter. The stock to be straightened enters the machine through a tube and passes between the rolls at the center of the machine. There are two rolls, one convex and the other concave. The relative position and shape of these rolls is such that the material is fed through the machine automatically. When in operation, the rolls grip the round stock, revolve it, carry it through automatically, and straighten it. It is seldom necessary to pass the stock through the machine the second time as it is generally found to be sufficiently straight for ordinary purposes after one passage through the machine. The machine will handle pieces from 8 inches to 30 feet in length if required, but it is generally employed for straightening pieces of from 3 to 10 feet long. The rolls are made of steel and are hardened. By turning the handwheel shown on the side of the machine, it can be adjusted for any diameter within the range of the machine. This machine occupies a floor space 24 by 60 inches, including the projecting arms which carry the tubing through the machine.

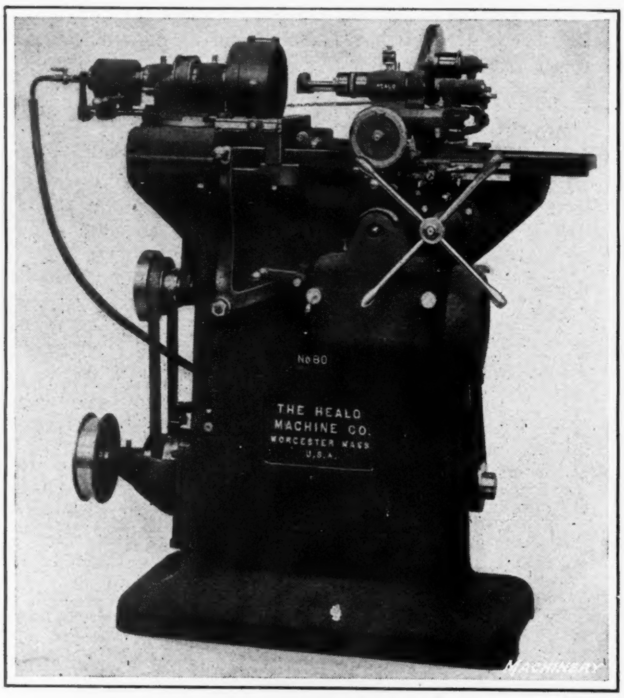
INGERSOLL-RAND PORTABLE AIR COMPRESSOR

The Ingersoll-Rand Co., 11 Broadway, New York City, has recently added an electrically driven portable air compressor to its line of "Imperial" gasoline-driven compressors. This new unit, which is shown in the accompanying illustration, is known as the Imperial Type 14 electrically driven portable compressor. It has a capacity of 118 cubic feet per minute, and the complete unit weighs approximately 4450 pounds, the weight depending upon the size of motor used.

This unit is especially adapted for the use of contractors, street railway, and public service companies which have electric current available for power purposes. It is of all-steel construction, light steel doors being provided which completely house the compressor and motor. This equipment can be furnished with alternating- or direct-current motor.



Portable Electrically driven Air Compressor built by the Ingersoll-Rand Co.



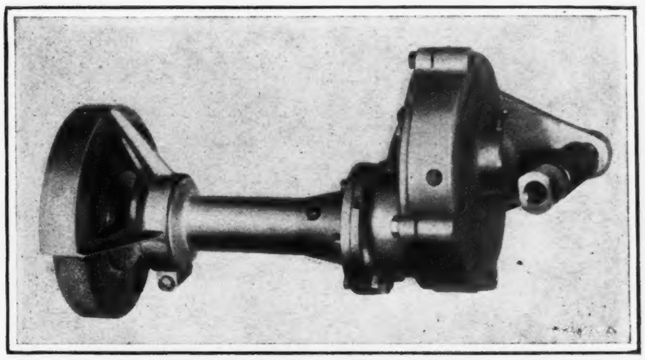
Grinding Machine built by the Heald Machine Co. for grinding Long Holes of Small Diameter

HEALD INTERNAL GRINDING MACHINE

The Heald Machine Co., 16 New Bond St., Worcester, Mass., has recently added to its line of products a No. 80 internal grinding machine, which is of practically the same design as the No. 85 machine described in the August, 1919, number of MACHINERY, except that the new grinder is intended for machining long holes of small diameter, whereas the previous one was intended for short holes of small diameter. The new No. 80 machine is provided with power feed for the grinding-wheel table in addition to the hand feed with which the No. 85 grinder is equipped. The makers state that the reason for this addition is because it is usually a difficult proposition to grind a long small hole by means of a hand feed when extreme precision is required, such as is generally necessary in tool-room work. With this arrangement, work longer than 1½ inches can be ground to a limit of 0.0001 inch or less.

Ordinarily, the power feed is used while the grinding wheel is in actual contact with the work, but as the wheel leaves the work, by pulling a vertical lever at the head end, which can be plainly seen in the illustration, the operator disengages the clutch operating the power feed and engages one connecting the hand feed. In this way, rapid hand movement of the table away from the work is obtained. At the same time a guard automatically swings over the wheel, the flow of water ceases, and rotation of the work stops, making gaging or removal of the work instantly possible.

A two-step cone drive provides two speeds of travel for the table with the power feed, and this travel can be reversed accurately at any point. The wheel-head provided on the machine is known as the Type 11, and has a solid adjustable taper bearing at the wheel end and ball bearings at the pulley end. The machine is suitable for grinding holes ranging from ¼ to 2 inches in diameter and up to a maximum length of 3¾ inches. The actual swing is 6 inches inside the water guard and 10 inches with the guard removed. The floor space required is 28 by 56 inches, and the weight, 1300 pounds.



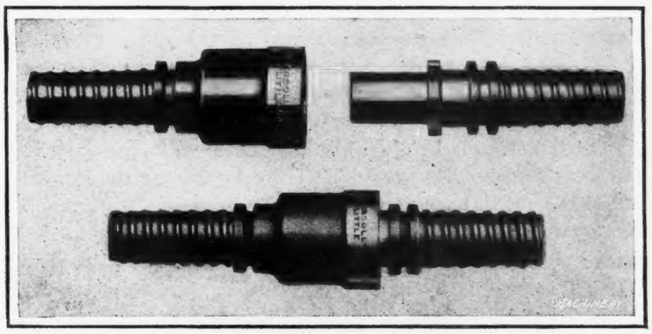
Air-operated Machine for driving Grinding Wheels, etc., built by the Turbine Air Tool Co.

TURBINE PNEUMATIC GRINDER

A pneumatically operated machine designed for driving grinding wheels, wire brushes, buffing wheels, etc., for grinding and cleaning castings and for buffing or polishing metals of all kinds, is made by the Turbine Air Tool Co., 710 Huron Road, Cleveland, Ohio. Some of the advantages claimed for this machine are lightness of weight, compactness of construction, small number of parts, and absence of vibration. The housing is made of aluminum, the turbine of a special aluminum alloy having the tensile strength of steel, the gears of nickel steel, and the pinions of chrome-vanadium steel. The grinder is fitted at one end with an air throttle, while a shank on the other end furnishes a grip for the operator to guide the machine over the work. When equipped with a wheel 6 inches in diameter, the peripheral speed is about a mile a minute. The weight, with a wheel 6 inches in diameter and 1 inch thick, is 16 pounds.

INGERSOLL-RAND AIR-HOSE COUPLINGS

Hose couplings which leak after a short period of use are the cause of serious air losses, both in small shops and in large plants using hundreds of connections. Another trouble commonly experienced is that the couplings jam or stick through some slight injury, and these tendencies make them difficult to connect or disconnect. With the idea of eliminating such troubles, the Ingersoll-Rand Co., 11 Broadway, New York City, has added the type of coupling here illustrated to the line of "Little David" pneumatic equipments of its manufacture. The main feature claimed for this coupling is a sturdiness and simplicity of construction which will stand lots of abuse without impairing its surface. As shown in the upper portion of the illustration, the coupling consists of two parts, male and female. These parts are made of a metal which is not subject to ordinary corrosion. The female end is fitted with a V-shaped rubber gasket to provide an airtight joint. This gasket is prevented from being blown out in the event that the coupling becomes accidentally disconnected under pressure, by a protective shoulder inside the coupling. The locking shoulders have large bearing surfaces and the locking spring can be replaced when necessary.

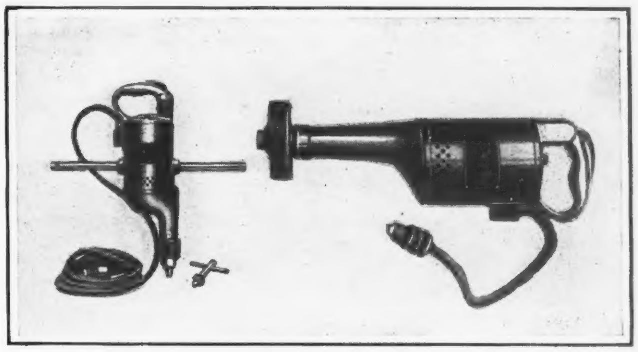


Disassembled and Assembled Air-hose Coupling manufactured by the Ingersoll-Rand Co.

The male end has a liberal bearing in its mating part to assure proper alignment and long wear. The air ports are straight and of uniform diameter, thus offering a minimum amount of resistance to the air. The coupling may be connected and disconnected by a quarter turn. Grooves are provided on the hose end of each part to allow the use of a clamp in attaching hose to the coupling. These couplings are manufactured in ½- and ¾-inch sizes which are interchangeable, that is, a ½-inch male section may be used with a ¾-inch female end, or vice versa.

WODACK PORTABLE ELECTRIC TOOLS

The Wodack Electric Tool Corporation, 23-27 S. Jefferson St., Chicago, Ill., is manufacturing a portable motor-driven drill, suitable for operation on either alternating or direct current. A feature of this drill, which is shown at the left in the accompanying illustration, is that the current is automatically disconnected when the operator releases his grip on the handle. This is effected by having a switch of the "quick make and break" type located in the handle and actuated by the palm of the operator's hand. In this way, the current is shut off instantaneously with the release of pressure. The drill is made in the following six sizes: 3/16, 5/16, ⅜, ½, ⅝, and ¾ inch the nominal size representing the diameter of the hole which the drill is capable of machining in steel.

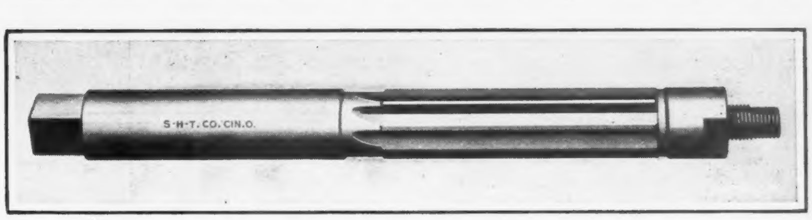


Portable Motor-driven Drill and Grinder made by the Wodack Electric Tool Corporation

In addition to this drill, the concern is manufacturing the portable grinder shown in the illustration at the right, which is equipped with the same style of control as the drill. This grinder is suitable for smoothing castings and buffing or polishing parts, being made in three sizes. Both the drill and grinder are fitted with motors manufactured by the maker of these tools. They have been designed to withstand severe usage and overloading. The casings are made of aluminum, and S K F ball bearings are used throughout the construction.

SCHELLENBACH-HUNT EXPANSION HAND REAMER

The illustration shows an expansion type of hand reamer which is a recent product of the Schellenbach-Hunt Tool Co., Cincinnati, Ohio. This reamer is split the length of the



Expansion Hand Reamer made by the Schellenbach-Hunt Tool Co.

teeth, and is expanded by means of a taper-threaded screw which engages with tapped threads at the starting end of the reamer. The ends of the teeth are ground at an angle on the outside, and they are locked in the adjusted position by means of a beveled locking nut as shown. The construction of the reamer permits quite a large range of expansion, 0.025 inch or more being easily obtainable on a ½-inch diameter reamer. Corresponding increases in diameter are possible on the larger sizes of reamers. The adjusting screw and locking nut are hardened.

"SACREY" OIL-GROOVING MACHINE

A machine for cutting practically every type of oil-groove, including straight, cross, and right- or left-hand helical, on internal and external surfaces of parts, has been developed by the Philadelphia Engineering & Machine Co., 1130 Race St., Philadelphia, Pa. This machine is known under the trade name of "Sacrey," and is shown in the accompanying illustrations. It may be driven from a lineshaft or by a constant-speed ¾-horsepower motor. The work is held stationary in a chuck at the top of the machine and the cutter

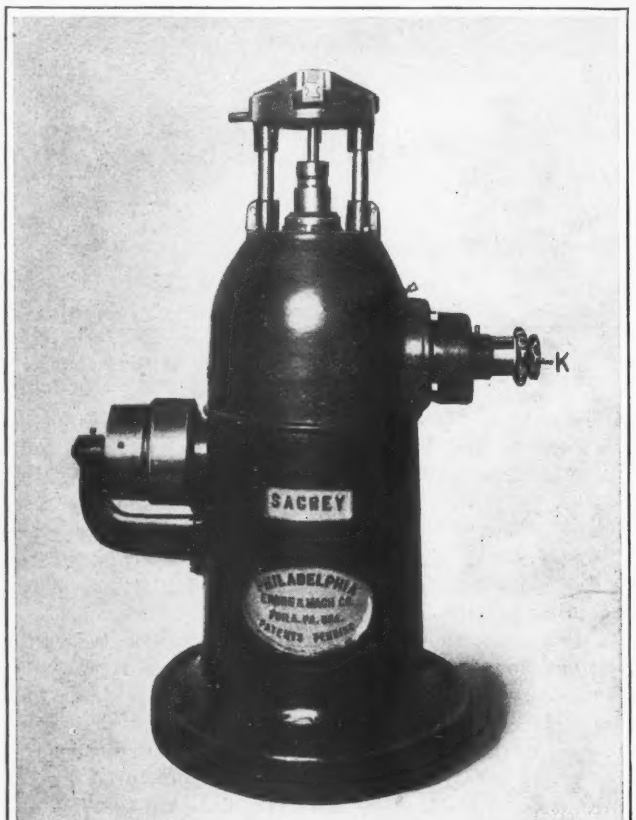


Fig. 1. "Sacrey" Oil-groover made by the Philadelphia Engineering & Machine Co. for cutting Grooves on Internal and External Surfaces

rotates, reciprocates, or performs both movements, according to the type of groove that is to be produced.

The main driving shaft is held in a horizontal position and is connected to the vertical shaft *A*, Fig. 2, through a set of bevel gears. At the upper end, shaft *A* is connected by means of change-gears with the spindle driving shaft *H*, which is in two sections, the lower section being driven from the upper by means of a hardened steel clutch, so constructed that the machine is adapted to the cutting of multiple oil-grooves. This clutch is engaged and disengaged by operating the knurled spring plunger *B*, which is mounted on the feed-box panel and adjacent to all other operating levers. By disengaging this clutch, the rotation of the cutter-spindle is stopped, but it may still be operated vertically, this arrangement permitting the cutting of straight grooves.

The necessary movement for bringing the grooving tool

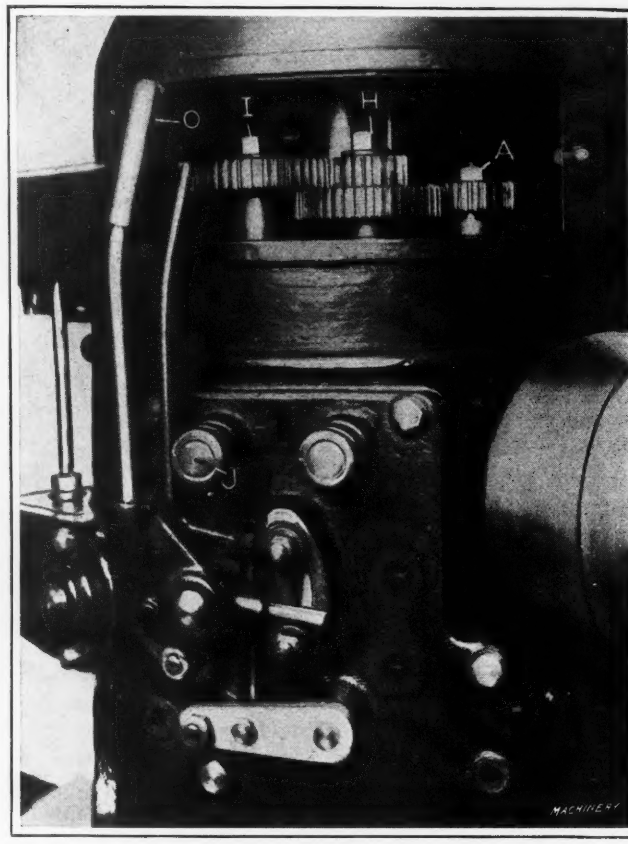


Fig. 2. Close-up View of Control Levers and Mechanism at the Operating Side of the Machine

in contact with the work after the latter has been inserted in the chuck is obtained in the following manner: Mounted on shaft *H* below the clutch there is a steel spiral gear *C*, Fig. 4, which engages with a bronze spiral gear *D* mounted on the lower end of the feed sleeve that surrounds the spindle located at the center of the machine. Spiral gear *D* has a much wider face than gear *C* so that when the latter is moved vertically by the clutch lever *E*, operated by handle *O*, Fig. 2, the feed sleeve is rotated 30 degrees, due to the cam action of the teeth on one gear when slid along those of the other. This rotation brings cam *F*, Fig. 4, on the sleeve into contact with a hardened roller carried on the lower end of the pivoted cutter-bar holder, giving the holder a rocking motion and feeding the tool into the work. The cutter-bar holder is held against the cam by a long flat spring *G*. A tapered hole is provided at the top of the holder, into which the cutter-bars fit and are held by a locking nut. By this means it is possible to readily change from a small to a large bar, according to the size of work that is being done.

The rotary movement of the cutter is obtained by means of a set of spur gears connecting the spindle and shaft *H*

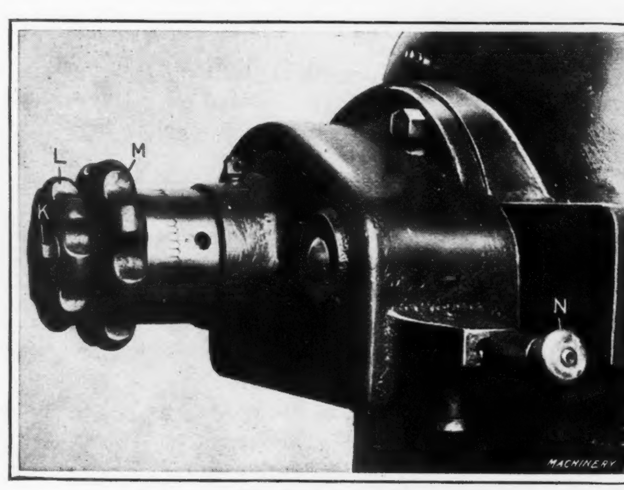


Fig. 3. Knobs at End of Crankshaft which control the Crank Stroke

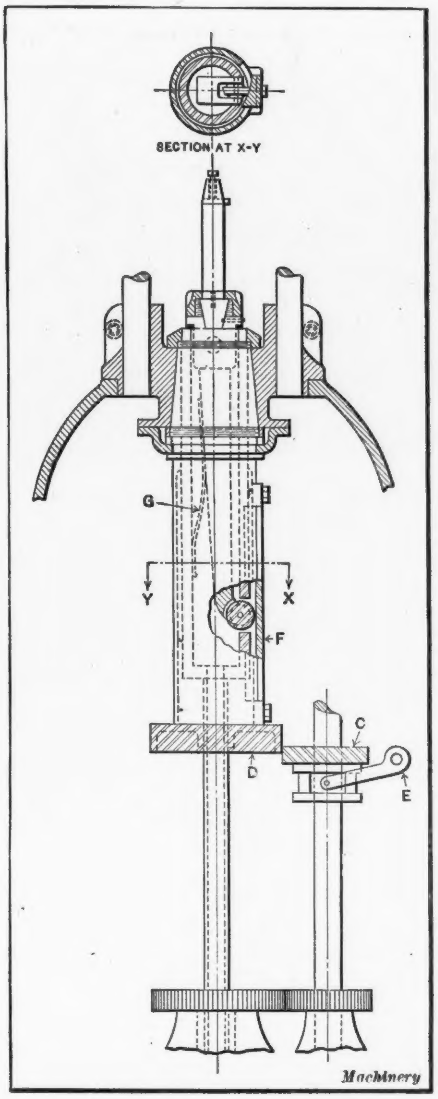


Fig. 4. Construction of Cutter-holder, Spindle and Sleeve

near their lower ends, and a reciprocating motion is accomplished as follows: At the top of shaft *H* there is a second change-gear which meshes with another gear carried at the top of shaft *I*. This shaft is also in two sections which are connected or disconnected by a clutch operated through the spring plunger knob *J*. At the lower end of the shaft there is a spur gear engaging an idler meshing with another gear mounted on the lower end of a vertical shaft which, in turn, drives the horizontal crankshaft *K*, Figs. 1 and 3, through the medium of bevel gearing. The crank on shaft *K* is connected in a suitable manner to the spindle, and imparts to it the reciprocating movements. The stroke of the crank is adjustable by increments of 1/8 inch from 0 to 7 inches, this adjustment being easily accomplished by loosening the locking knob *L* and then turning knob *M* to the graduation on the sleeve indicating the desired stroke. This adjustment is absolutely positive, because teeth in the collar mounted on the crankshaft fit similar teeth on knob *M*.

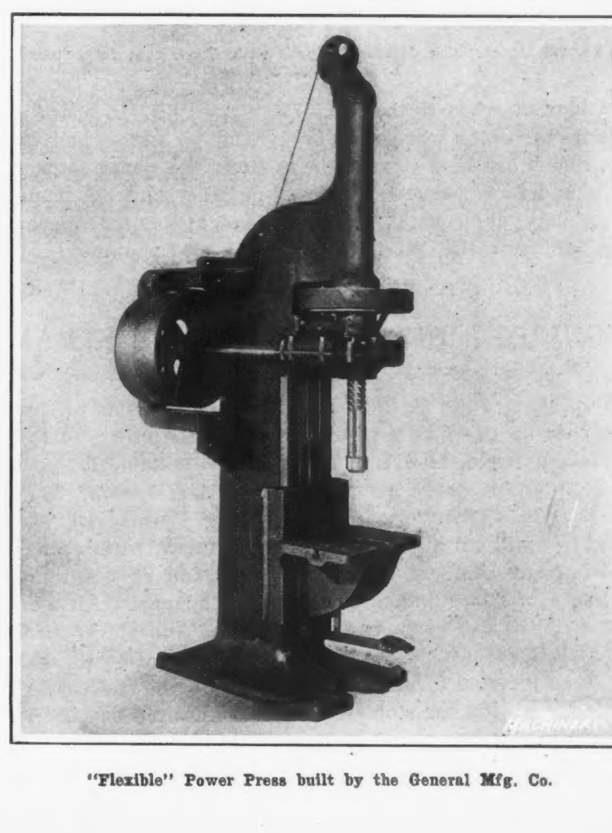
The machine is adapted to the cutting of intermittent grooves by simply turning knob *N*. This causes a roller carried on a bellcrank to be thrown in contact with one of two cams on the crankshaft. The resulting motion is imparted through the bellcrank to the spiral gear *C*, Fig. 4, and moves the gear up and down its shaft from one to four times per revolution of the cutting tool. Of course, the number of movements depends upon the change-gears connecting shafts *H* and *I*, Fig. 2. The work-holding chuck is attached to two upright steel posts at the top of the machine and is adjustable up and down to accommodate various lengths of bushings or other work in which oil-grooves are to be cut. The chuck is of the three-jawed scroll type and is quickly opened and closed by means of a handle. Work up to 4½ inches in diameter may be held in the chuck body.

An adjustable arm mounted on one of the upright posts serves as a stop to locate the work when it is placed in the chuck. The vertical construction of the machine permits the handling of a large variety of sizes or shapes of work, as special fixtures can be designed for many cases. In quantity production, all grooves are cut with the automatic feed, while hand feed may be used for small lots. Provision of an automatic feed permits the machine to be operated by girls or unskilled help. Double-row ball bearings are furnished to take up the thrusts on the spindle and the crankpin. All other bearings are made of phosphor-bronze. The large exterior bearings are equipped with oilers, and the interior bearings are lubricated by tubes from a central reservoir.

"FLEXIBLE" POWER PRESS

The General Mfg. Co., Detroit, Mich., has recently brought out a machine known as a "flexible" power press which is shown in the accompanying illustration. As the name implies, the amount of pressure exerted by the press is flexible or variable. By simply pressing down on a foot-pedal, the operator can obtain any desired pressure from a few pounds up to 20 tons, the pressure exerted on the work by the ram being in direct proportion to the amount of pressure applied to the pedal. This feature makes the machine especially adapted for performing straightening operations on a large variety of work. The press is also particularly well adapted for performing such operations as push-broaching, pressing in bushings, and assembling gears on shafts. The ram, having a stroke of 18 inches and a maximum distance of 28 inches above the adjustable table, gives the machine a capacity for work of considerable size.

The machine is belt-driven and power is transmitted to the ram through a 10 to 1 ratio worm-gear, which runs in oil and which has two 5/8-inch splines that are a sliding fit in keyways cut in the ram. The ram rotates at a constant speed and is caused to advance by pressing down on the foot-pedal. Pressure on this pedal causes a brake-band to tighten about a drum in which the ram is threaded. When the foot-pedal is in its normal position, with the brake-band released, the drum rotates with the ram and no forward motion is imparted to the ram. When the foot-pedal is depressed, the brake-band is engaged, stopping the drum rotating. This causes the ram to travel down at 100 to 140 inches per minute, as determined by the speed of the driving pulley, until the brake-band slips or the foot-pedal is released, at which time a counterweight inside the column gives a quick return to the ram. During the return movement, the drum spirals or turns on the threaded ram, the end thrust being taken by a ball bearing between the drum and the main casting. The knee adjustment is made by means of a rack and pinion, and the knee is held at any desired height by clamp gibs secured by six nuts, and a spring plunger engaging a ratchet cast integral with the column.

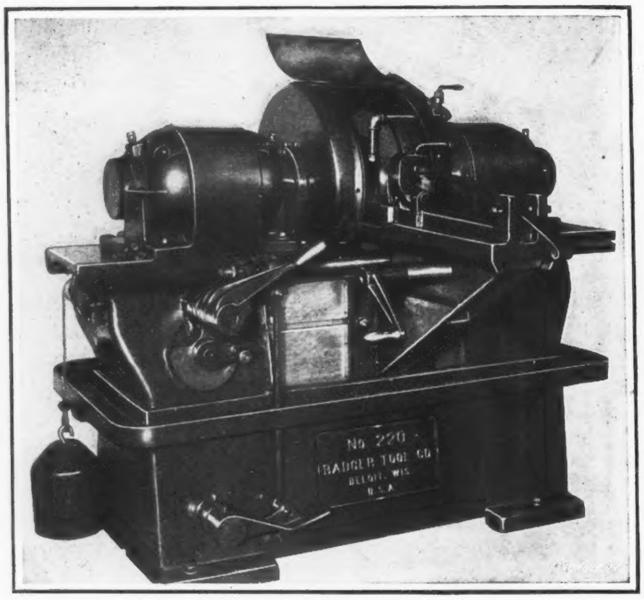


"Flexible" Power Press built by the General Mfg. Co.

BADGER GRINDER ATTACHMENT FOR OPERATION ON LEAF SPRINGS

In the manufacture of leaf springs, it is necessary to grind each eye to a specified length to fit the spring shackle, and, to facilitate this operation, the Badger Tool Co., Beloit, Wis., has produced an attachment which is shown in the accompanying illustration mounted on a No. 220 motor-driven disk grinder. This attachment consists of a support carrying a sliding ram which is caused to move in and out between the grinding wheels by means of a rack and a pinion rotated by the crank at the front of the machine. The eye of the spring to be ground rests in a hardened V-block attached to the rear end of the ram, adjustable upright lugs being provided to locate the spring so that the ends of the eye will be ground parallel to the general axis of the entire spring. A quick-acting clamping screw locks the spring in position for the operation.

A sheet-metal pan which was removed from the machine at the time that the photograph was taken, encloses the attachment, and this pan, together with the wheel-hoods and drip-pans that completely surround the machine base, confines the grinding compound and causes it to be returned to

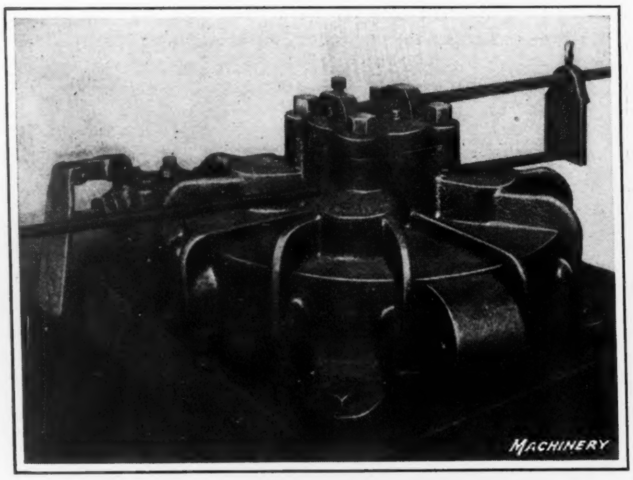


No. 220 Badger Disk Grinder equipped with Attachment for grinding Eyes of Leaf Springs

the tank attached to the machine at the rear. In operation, the two grinding wheels are brought up to a stop, and after the spring has been clamped in position, the spring is passed back and forth between the grinding wheels in the manner previously described. The total weight of the machine equipped with the attachment is about 3800 pounds.

SCULLY-JONES PNEUMATIC OR STEAM ROD-CUTTERS

Two sizes of rod-cutters, one of which is capable of shearing rods up to 3/8 inch in diameter and the other up to 5/8 inch in diameter, and both of which are suitable for operation either by air or steam, have been developed by Scully-Jones & Co., 647 Railway Exchange Bldg., Chicago, Ill. These machines will cut all sizes within their range, without necessitating any changes or readjustments, and at a minimum pressure of 60 pounds. The only moving part with which the operator can come in contact is the knee lever at the left, which is operated to move the cutters, after the work has been inserted through the device, until the end comes in contact with the bar stop set to suit the desired length. The cutters are of the round ring type, and are provided with ten cutting edges which can be used successively as the pre-



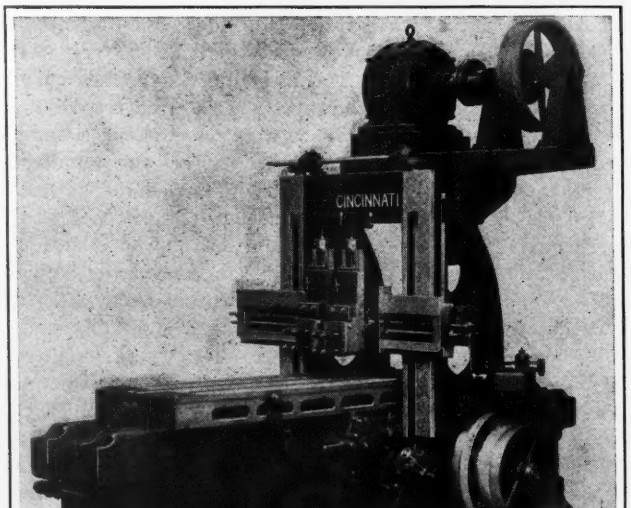
Rod-cutter made by Scully-Jones & Co., which is operated by Air or Steam

ceding one becomes worn. The travel of the piston in the 3/8-inch machine is 1/2 inch, and that in the 5/8-inch machine is 7/8 inch. The machines are suitable for installation on permanent benches or on portable ones. They are particularly adapted for use in foundry core-rooms, machine and blacksmith shops, etc.

CINCINNATI SHOE AND WEDGE PLANER

The 30-inch shoe and wedge planer shown in the accompanying illustration was especially designed by the Cincinnati Planer Co., Cincinnati, Ohio, to withstand severe conditions of service. The extra-heavy box bed is cast closed on the top for its entire length, except where the bull gear meshes with the rack. The machine is equipped with forced lubrication, herringbone gears, and all-steel gearing. The box table is made of unusual depth and strength, to overcome all possibilities of springing. The stop holes are drilled all the way through the upper half of the table to eliminate the necessity of cleaning out the holes before inserting a stop, while the lower half of the table is cast solid to prevent dust and chips from working into the vees of the bed.

The housings are fastened to the sides of the bed, and their faces are liberally proportioned to furnish sufficient bearing surfaces for the cross-rail. The heavy box arch employed to tie the housings together at the top gives increased strength and rigidity. Both tool-heads are mounted on one saddle, so that they move transversely in unison, but provision is

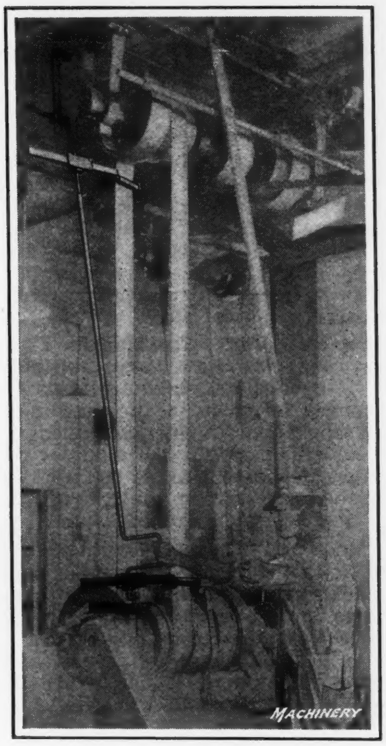


Shoe and Wedge Planer recently developed by the Cincinnati Planer Co.

made for operating them in a vertical direction independently by hand or by power. The machine is regularly equipped with a patented two-speed countershaft, but it can be arranged for a plain or variable-speed motor drive as shown.

HASKINS BELT SHIFTER

The R. G. Haskins Co., 27 S. Desplaines St., Chicago, Ill., has recently placed on the market a device known as the "Spurgin" belt shifter. It is claimed that this device not only permits the belt to be shifted quickly and without apparent effort on the part of the operator, but that its use also results in doubling or trebling the life of a belt, due to the frictionless guides. The manner in which the shifter is operated will be apparent from the accompanying illustration. Steel is used in the construction of the shifter wherever possible, and its durability is said to have already been thoroughly demonstrated through results obtained from its use in several large manufacturing plants. The use of this belt shifter allows belts to be shifted without danger of accidents; the production rate is increased by always operating the machine at a suitable speed.

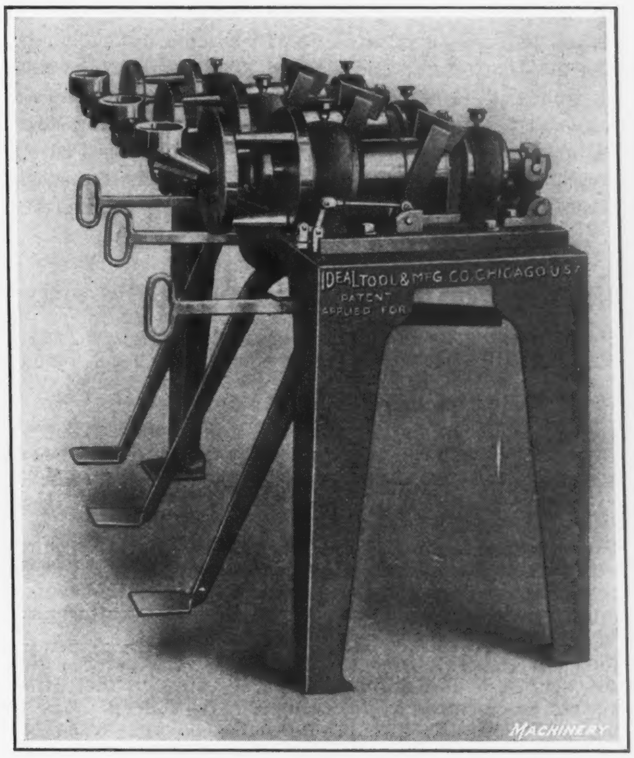


"Spurgin" Belt Shifter developed by the R. G. Haskins Co.

CENTRIFUGAL BABBITT LINING MACHINE

Die-casting machines have been generally employed in the manufacture of babbitt-lined bronze bearings such as are extensively used for automobile engine crankshaft bearings, and also in electric motor bearings. The machine here described may also be termed a die-casting machine, but it operates on an entirely different principle from the usual type. As a result of carefully conducted experiments, the Ideal Tool & Mfg. Co., 5825-5829 S. Western Ave., Chicago, Ill., has succeeded in producing the machine shown in the accompanying illustration, by means of which it is claimed that the babbitt and bronze can be united as a single piece. When in operation this machine holds the molten babbitt against the bronze bushing by centrifugal force, until it is properly cooled. The machine shown is a three-spindle equipment, and each of the spindles runs at 1800 revolutions per minute. The employment of three spindles keeps the operator constantly at work loading and unloading the machine, and at the same time allows the metal to cool sufficiently before removal. The output of a machine of this type is approximately 700 bearings a day. The thin wall of babbitt left in a bushing after it is properly bored to size ready for the motor housing, and the close-grained condition of the babbitt, which is evenly distributed by centrifugal force, give to a bearing made by this process the appearance of being a single piece of metal, except for the difference in the colors of the two metals.

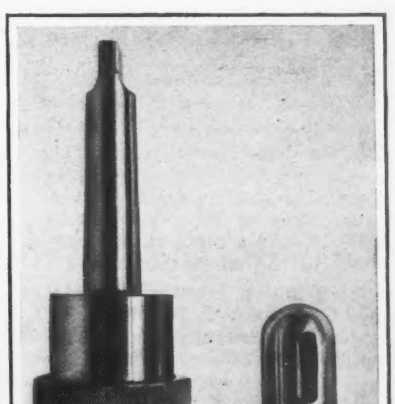
The advantage of making a bearing by this process is that while the babbitt is shrinking and actually pulling together, the centrifugal force is pulling in the opposite direction, and tends to hold the metal in place close to the bronze back until both metals have cooled. The machine is equipped with extra heavy type SKF ball bearings throughout. A belt-shifting mechanism is provided for each spindle which works in conjunction with the brake for starting and stopping the spindles. The loading and unloading is accomplished by the operation of a pedal which is within easy reach of the operator's foot. Separate chucks are, of course, provided for bushings of different sizes. The principal specifications are as follows: Weight, 1200 pounds; length over all, 48 inches; width, 24 inches; height, 48 inches; speed, 1800 R. P. M.; and speed of countershaft, 600 R. P. M.



Machine built by Ideal Tool & Mfg. Co., for lining Bronze Bushings with Babbitt

DOMPIER QUICK-ACTION SLIP-COLLET CHUCK

A new type of slip-collet chuck adapted to the performance of drilling, reaming and boring operations, etc., and which permits instant removal of the tool when necessary, is being manufactured by the Dompier Chuck Co., 446 Book Bldg., Detroit, Mich. The collet, as well as the various parts which enter into the construction of the chuck proper, is made of 0.20 per cent carbon steel, carburized, hardened, and ground. The chuck can be used at any speed and can be placed in any desired position. It is locked in place by tapered keys, and in order to remove a collet it is simply necessary to push back the spring-actuated knurled sleeve



Quick-action Slip-collet Chuck manufactured by the Dompier Chuck Co.

with one hand and slip out the collet with the other. If another collet is substituted, it will become locked in place when the knurled sleeve is released. The shank on the chuck is a standard Morse taper and this is also true of the hole in the collet. The chuck is made in four sizes having Nos. 2, 3, 4 and 5 Morse taper shanks, respectively. Each size of chuck accommodates two or more sizes of collets, the sockets of the latter ranging from Nos. 1 to 5 Morse taper, inclusive.

NEW MACHINERY AND TOOLS NOTES

Hand-operated Grinder: Luther Grinder Mfg. Co., 285 S. Water St., Milwaukee, Wis. A hand-operated bench grinder for use in sharpening drills, chisels, and similar small tools where power-driven grinders are not available.

Kerosene Torch: Mahr Mfg. Co., Minneapolis, Minn. A self-contained kerosene torch known as style T, for use in foundries, tin shops, machine shops, or wherever a small heating appliance is required. This torch is made in ½,-1,- and 1½-gallon sizes.

Blueprinting Lamp: J. H. Wagenhorst & Co., Youngstown, Ohio. A twin arc lamp especially suitable for vertical types of electric blueprinting machines. The arc is designed to operate at high speed, and it will produce a uniform distribution of light of a color duplicating daylight.

Fuel Oil Heater: Griscom-Russell Co., 90 West St., New York City. A heater designed for preheating oil fuel before it goes to the burners of oil-burning foundry cupolas. The oil is heated by passing through two coils enclosed by a high-pressure steam container, thus insuring proper vaporization.

Metal-cutting Machine: Metal Saw & Machine Co., Inc., Springfield, Mass. A horizontal metal-cutting machine with a capacity for cutting metals up to 4 by 4 inches, which is known as the "Horizontal Junior," to distinguish it from the 10- by 10-inch horizontal Napier metal-cutting machine of this company's manufacture.

Solders: Rohde Laboratory Supply Co., 17 Madison Ave., New York City. A line of solders, each one intended for a certain class of work or material. This line includes solders especially adapted for soldering sheet aluminum and aluminum castings, also a general utility solder intended for joining iron, brass, lead, nickel, tin, and zinc.

Cutting-off Tool: Rigid Tool-holder Co., Washington, D. C. A device consisting of a narrow cutting-off tool of high-speed steel, held by a hardened steel clamp on the base of the holder, which is a steel casting. The tool can be held by the toolposts of a lathe, and swung to cut on either the right or the left, the cut being made from the rear.

Self-locking Hub Plate: J. P. Finerty & Co., Dunmore, Pa. A self-locking hub plate for locomotive driving-boxes, which is made in two pieces, so that it may be slipped into an under-cut recess in the driving-box. As the under-cut recess is made slightly eccentric with the bore the crown brass acts as a key, thus holding the hub plate firmly in place.

Electric Controllers: Allen-Bradley Co., 286 Greenfield Ave., Milwaukee, Wis. A new line of controllers for alternating or direct current, made in sizes ranging from 1 to 150 horsepower. These controllers are known as the "Clapper" type, and are intended to supplant the Q, R, and S mill, crane, and hoist controllers of this company's manufacture.

Grinding Attachment for Portable Drill: Arnold Electric Tool Co., Inc., New London, Conn., and 114 Liberty St., New York City. A grinding attachment made for use on the Type B portable electric drills of this company's manufacture. A frame carrying the wheel-spindle is clamped to the body of the drill, and a plate running on the sleeve chuck transmits power to the wheel-spindle.

Self-gripping Mandrel: Eastern Tube & Tool Co., Inc., 41-59 Gardner Ave., Brooklyn, N. Y. A self-gripping mandrel for holding bushings, gears, and similar parts for turning or grinding operations. When the cut is applied to the work, three rollers in the body of the mandrel are caused to wedge and grip the work rigidly. Parts can be slipped on or off the mandrel by simply turning them slightly to the left.

Oilstone Holder: J. A. Raught, 1006 Grand Ave., Racine, Wis. A self-cleaning oilstone holder made of cast aluminum, the surfaces being ground and polished. The stone lies in a bath of oil, thus keeping one side of it soaked. In this way the stone can be prevented from clogging and glazing, as it is kept clean and sharp. The holder is made in sizes to hold stones 1 inch thick, 2 inches wide, and either 6, 7 or 8 inches long.

Bench Centers: Cadillac Tool Co., 268 Jefferson Ave., Detroit, Mich. A line of bench centers built in seven sizes ranging from 6 by 18 inches up to 12 by 60 inches. The bed is a ribbed casting of box form construction, and the ways are scraped. Both of the stocks which carry the centers can be moved to accommodate work of various lengths. Conveniently located levers are provided for clamping the stocks in position.

Electric Furnace: Industrial Electric Furnace Co., 53 W. Jackson Blvd., Chicago, Ill. An electric furnace for melting steel and non-ferrous metals, known as the Von Schlegell arc furnace. This furnace can be operated from 220-volt motor circuits, and the self-regulating flaming arc torch with which it is provided can be suspended in various kinds of chambers for obtaining high temperatures with deoxidizing conditions maintained.

Metal-cutting Band Saw: Seattle Machine Works, 37-51 W. Lander St., Seattle, Wash. A metal-cutting band saw intended for cutting out solid forged crankshafts, for cutting slots, and for cutting pieces to length. When cutting pieces to length, the saw cuts on both sides of its loop, the cut, of course, being downward on one side and upward on the other. Two idlers having horizontal adjustment are provided for setting the machine to cut to any desired length.

Metal-testing Machine: Holz & Co., Inc., 17 Madison Ave., New York City. A static notched-bar testing machine for the quantitative measurement of the brittleness and ductility of steel and other metals. This machine was designed and patented by J. C. W. Humfrey. It yields an autographic record of the bending-angle, bending moment diagram, and is equipped with an automatic integrator which gives the total energy absorbed in breaking the test piece.

Multiple-spindle Tapping Attachment: Fox Machine Co., Jackson, Mich. A tapping attachment for use on multiple-spindle drilling machines of this company's manufacture. It is necessary that some changes be made in the machines when they are equipped for tapping. With this attachment a simple movement of a control lever causes the spindles to rotate in the right-hand direction. A stop is set to trip the mechanism and cause the spindles to reverse their direction of rotation when the taps have reached the desired depth.

Semi-automatic Drilling Machine: Detroit Machine Tool Co., 1487 St. Antoine St., Detroit, Mich. Improvements on the semi-automatic multiple-spindle drilling machine of this company's manufacture, including the incorporation of a clutch on the worm-shaft which operates the camshaft worm-gear, thus permitting each spindle to be advanced to the extreme position without stopping the machine while the fixture is clamped in position for drilling to the required depth. Another improvement is the addition of a work-holding pan.

Core Machine for Foundry: E. J. Woodison Co., 1681 St. Aubin Ave., Detroit, Mich. A core machine operated by compressed air, which has an output of 180 cores an hour. To make a core by the use of this machine, it is simply necessary to put the core-box in place on the machine and give the control handle a quarter turn. The cores produced by this machine have a natural venting, because the air is forced through the core, thus carrying the fine sand to the outside, giving a smooth surface and allowing all gas to pass off freely.

Double-carriage Lathe: Hamilton Machine Tool Co., Hamilton, Ohio. A lathe equipped with two independent carriages to enable turning and facing operations to be performed at the same time. The front carriage holding the turning tools runs on one V-way and one flat way, while the rear carriage carries the facing tools and runs on another set of ways. This machine is intended for production work on steering knuckles for automobiles and tractors, small shafts, axle parts, and gears of different types.

Multi-punch Press: Toledo Machine & Tool Co., Toledo, Ohio. A double crank type press with twin-gear drive, fitted with sixty independently adjustable punches and dies for punching holes with varying center distances. The punch-holders are fitted with gags in order that holes may be punched or omitted as desired. The press is capable of punching fifteen 1-inch holes through 15/16-inch steel. The weight is about 165,000 pounds, the width between uprights 103 inches, the opening in the bed 4 by 98 inches, and the maximum distance from bed to slide, 33 inches.

Self-loading Electric Truck: Cowan Truck Co., 50 Water St., Holyoke, Mass. An elevating platform electric industrial truck known as the I. T C., which is of all-steel construction and has a capacity of 5000 pounds with a lift of 4½ inches. The turning radius on the extreme outside point is 7 feet 10 inches, and it is claimed that the truck will operate in intersecting aisles 60 inches wide. A 24-volt, 50-ampere driving motor is employed, which runs at 1500 revolutions per minute, and a 24-volt, 35 ampere elevating motor is provided which has a speed of 1800 revolutions per minute.

Universal Gage Measuring Machine: Alfred Herbert, Ltd., 54 Dey St., New York City. A universal gage measuring machine known as the Wickman, which is intended for measuring length gages up to 12 inches long, outside, pitch, and

root diameters of screw and plug gages up to 6 inches in diameter; pitch of screw plug gages up to 4 inches in diameter; and outside, pitch, and root diameters of screw ring gages up to 3 inches in diameter. This machine is claimed to be accurate within 0.000005 inch when used as a comparator, or within 0.00001 inch when used in the regular way.

Thread Snap Gage: Alfred Herbert, Ltd., 54 Dey St., New York City. A gage known as the Wickman adjustable snap gage for measuring threads. The gage consists of a U-shaped frame such as used for plain snap gages, which is provided with grooved anvils to suit the pitch which is to be measured. Two sets of anvils are used on each gage, the front and rear anvils being of different form. The teeth of the front set are made to conform exactly to the profile of the screw thread. The second or inner set of anvils is used to detect thin threads which are not within the tolerance allowed on the work.

Electric Truck for Handling Annealing Pots: Elwell-Parker Electric Co., 4223 St. Clair Ave., Cleveland, Ohio. A truck driven by an electric motor, which receives its power from a storage battery. The three wheels of the truck may be equipped with rubber tires when the oven is charged at low temperatures, or with a smooth steel wheel at the steering end, and a pair of herringbone steel driving wheels at the front end when the oven temperatures are high at the time of charging. The truck has an especially short turning radius and is so equipped that it will automatically stop should the operator step off the truck while it is in motion.

Instrument for Checking Testing Machines: Holz & Co., Inc., 17 Madison Ave., New York City. An instrument known as the Amsler standardizing box for checking tensile and compressive loads of testing machines of either lever or hydraulic types. This instrument can be used for checking horizontal and vertical testing machines, and is acted upon by the testing machine in exactly the same way as the test bars are. The load acting on the instrument is read off on a direct-reading scale which forms a part of the instrument itself. The boxes are made universal, that is, for measuring both compressive and tensile loads of 20,000, 60,000, and 100,000 pounds maximum.

Gear-measuring Machine: Alfred Herbert, Ltd., 54 Dey St., New York City. A machine known as the Wickman gear-pitch and concentricity measuring machine, for testing gears before and after hardening. This test is usually made on one gear in each lot. The gear to be tested is mounted on a vertical arbor which is revolved by means of a handwheel. As the gear is revolved, the space between the teeth at the pitch circle and the concentricity of the pitch circle are measured. After the measurements have been taken in this manner, two curves are plotted from the data thus obtained, one showing the pitch error between the teeth and the other the concentricity error. This machine has a capacity for testing gears from 2 to 12 inches in diameter, and is provided with a vertical adjustment of 6 inches.

Planer: William Sellers & Co., Inc., Philadelphia, Pa. A 16-foot planer having the principal members made in two or more pieces to facilitate transportation by rail. The table is driven by the Sellers type of planer drive through a spiral pinion engaging a rack on the under side of the table. The spiral pinion is set at an angle of 33 degrees from the center line of the bed, and is about 24 inches long. With this drive at least four of the driving teeth are in contact at all times, which results in smooth action with no tendency for the rack or pinions to wear more at one point than at another. The motor is of the reversing planer type, of 75-horsepower capacity, having a speed range of 250 to 1000 revolutions per minute, which gives variable cutting speeds from 20 to 40 feet per minute. The motor rests on a separate baseplate, and is connected with the machine by a flexible coupling. The return speeds of the machine are selective between 40 and 80 feet per minute. A pneumatic device is provided for clamping the cross-rails to the uprights. This machine will plane work 16 feet in width, 13 feet in height, and 36 feet in length. The total weight is 412,300 pounds.

* * *

TYPOGRAPHICAL ERROR IN CROUSE-HINDS CO.'S ADVERTISEMENT

In December MACHINERY, in an advertisement of the Crouse-Hinds Co., Syracuse, N. Y., a line reading "Send for Conduit Catalog" should have read "Send for Condulet Catalog." The Crouse-Hinds Co. does not make or sell "conduit," and inasmuch as their specialties "Condulets" are used mostly in connection with conduit wiring, this correction seems essential.

TAPER THREADING OPERATION

An interesting manufacturing job was recently done in the plant of the S. A. Potter Tool & Machine Works, New York City, by making a slight modification in the regular thread-chasing attachment furnished with the precision bench lathe of this company's manufacture. This job consisted of cutting the threads on the tapered end of a special tool-steel sharpener used in sharpening the spiral cutters of an ordinary desk lead pencil pointing machine. The angle of taper of the tool is 15 degrees, as shown in Fig. 1, and it is required to cut 64 threads per inch on this tapered surface to a depth of 0.015 inch. The blanks were first rough-turned on automatic screw machines, special care being taken to maintain an accurate angle at the point. A special thread-chaser having about twenty teeth of the correct pitch was then made, and this tool was held in the regular toolpost of the lathe, as shown in Fig. 2. The work was held in a 3/8-inch collet chuck provided with an inside stop so as to enable the same relationship of the tool and each piece of work to be maintained throughout the job. The only other special part was a hardened steel master guide plate which was attached to the machine as shown at *A*, Fig. 2. The regular handle provided with the Potter thread-cutting attachment was furnished with a stylus *B* that rides on the upper angular surface of this plate, thereby swinging the tool radially outward simultaneously with its traverse, so that the tool follows the angularity of the tapered end of the sharpening tool. Fig. 2 also shows a number of the blank sharpeners lying on the bed of the lathe, as well as the gage by means of which

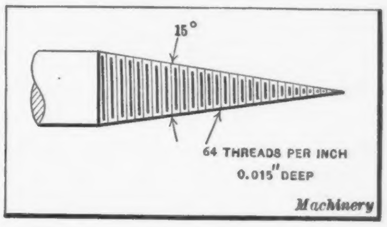


Fig. 1. Tapered End of Special Tool

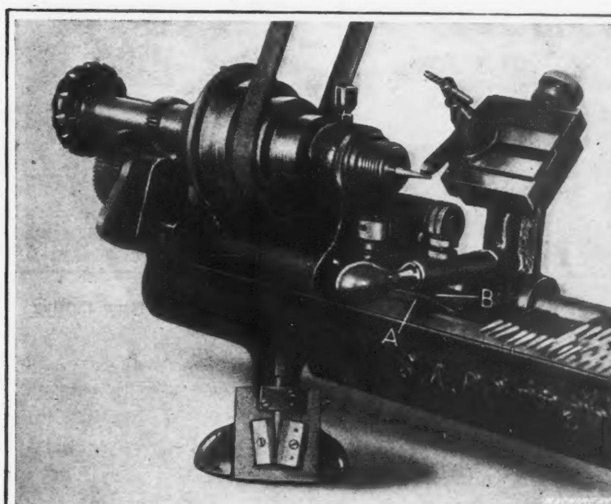


Fig. 2. Bench Lathe set up for threading Sharpening Tool shown in Fig. 1

the taper is inspected. The chasing attachment was geared up for a 64-pitch thread. As the chasing tool was fixed in the holder, it was only necessary for the operator to swing the arm over so that the stylus rested on the guide plate *B* and take one cut to complete the job.

* * *

DESIGN OF CIRCULAR FORMING TOOLS

In conjunction with the article "Design of Circular Forming Tools" published in the December number of MACHINERY, beginning on page 366, there appeared a table headed "Dimensions and Constants for Calculating Circular Forming Tools." Unfortunately the dimensions in column C were given without specifying that these dimensions apply only to tools having a rake angle of 8 degrees.

TRAVERSING MECHANISM FOR OXY-ACETYLENE CUTTING TORCH

The difficulties encountered in cutting 4000 tons of armor plate into charging-box sizes at the government proving grounds at Sandy Hook, N. J., resulted in the development of a mechanism for semi-automatically traversing a torch across the plates. The conditions were such that no straight-line cutting equipment on the market was adapted to the work. The armor plates were badly warped by the impact of shells which had pierced them in target practice, and the punctures, of which there were six in each plate, were mushroomed and ragged. Each of the plates was about 13 feet long, 9 feet wide, and 3 inches thick, and weighed between 7 and 8 tons. Besides the irregular surfaces, another difficulty arose due to the metal containing large percentages of nickel and chromium. Such a steel yields a heavy and viscous slag that does not flow freely from the kerf in blowpipe cutting. This condition not only retards the cutting speed, but necessitates higher oxygen pressures than are required in cutting ordinary steel of the same thickness.

However, the engineering difficulties were overcome by means of a machine developed at the Buffalo shops of the Linde Air Products Co., 30 E. 42nd St., New York City. This machine traverses across the plate a carriage holding in a vertical position an Oxweld C-7 torch, which is manufactured by the Oxweld Acetylene Co., Newark, N. J. The carriage and traversing mechanism are shown in the accompanying illustrations. Power for operating the machine is obtained from a phonograph spring motor. The turntable spindle of the machine has a worm that meshes with a worm-wheel on a horizontal shaft. On the outer end of the latter there is mounted a knurled-groove pulley, and above it there is another, but larger, similarly grooved pulley which is held down by spring tension. Through these rollers passes a jointed and knurled pull-rod, the outer end of which is attached to the torch carriage. From this description it will be understood that the torch is traversed across the plate as the pull-rod is drawn through the rollers when the motor is started.

By raising to a vertical position a lever pivoted on an idler shaft, a brake is applied to the driving shaft and, at the same time, the two rollers are separated, giving freedom to the pull-rod. The usual phonograph speed control is used, but a change was made in the governor weights of the motor to cause it to run faster. The wheels of the carriage are 3 inches in diameter and are made of cast iron, the wheels and their bearings being protected from sparks by metal shields. Runners are provided inside the wheels to prevent the carriage from falling off a plate at the beginning and end of a cut. Provision was made to keep the torch tip at a correct distance from the plate at all times in spite of the irregular surfaces of the warped armor, and the cut is also kept at the correct angle to the plate. The motor is fastened to a plate by means of a C-clamp, and may be readily moved to perform a new cut. In setting up the equipment, all that is necessary is to place the motor in such a position that the pull-rod extends across the line of cut. The entire equipment weighs less than 30 pounds.

Fig. 1. Mechanism designed to traverse an Oxy-acetylene Cutting Torch across Armor Plates

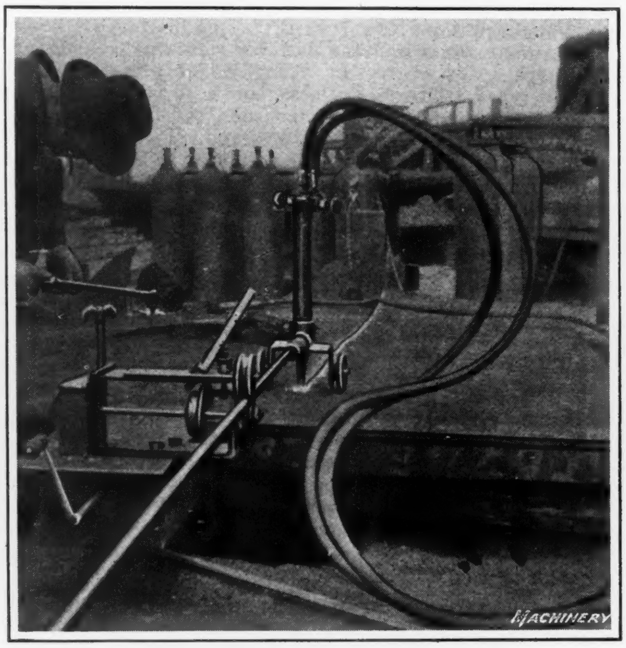


Fig. 2. Illustration clearly showing Rollers and Knurled Pull-rod drawing Torch Carriage

* * *

WINTER MEETING OF THE SOCIETY OF AUTOMOTIVE ENGINEERS

The annual meeting of the Society of Automotive Engineers will be held January 11 to 13 in the Engineering Societies' Building, New York City. The meeting coincides with the New York Automobile Show. Tuesday, January 11, the Standards Committee will meet both morning and afternoon. Wednesday morning, January 12, there will be a business session, and in the afternoon there will be simultaneous sessions by the Body Engineering Section and the Aeronautic Section. Thursday morning, January 13, there will be a fuel research session, and in the afternoon a continuance of the fuel research session and two other sessions on highways and on chassis design.

During the fuel research session new and interesting chemical and physical phenomena of combustion will be disclosed. The body engineering session will be devoted to the presentation of means to reduce body weight, a consideration of passenger-car body styles and a discussion of problems of construction. The aeronautic session will include a paper on the present status of commercial aviation in America and Europe, a study of recent developments in airplane design, and a discussion of the possibility of successful operation of commercial lighter-than-air craft. Because of the direct relation of the motor vehicle to the good-roads movement, it has been decided to devote one technical session to highways. It is planned to familiarize the members of the society with the progress highway engineers are making with the problems of highway deterioration. The chassis session is intended to cover the relation of chassis design to fuel economy. This naturally includes the question of light weight, higher transmission and axle efficiencies, and the reduction of rolling resistance.

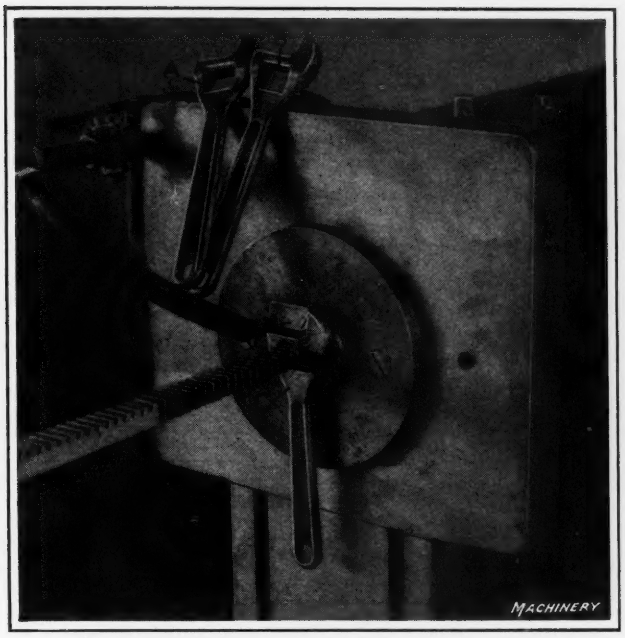


Fig. 1. Broaching a Rectangular Opening in a Wrench Part

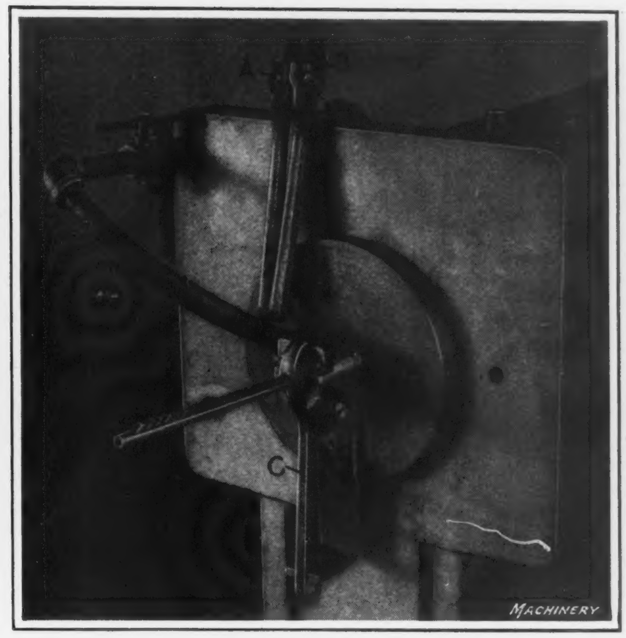


Fig. 2. Operation in which Two Broaches are employed

BROACHING OPERATIONS ON AN ADJUSTABLE JAW WRENCH

Three machining operations on the main section of an adjustable jaw wrench are rapidly and successfully performed on a No. 1½ broaching machine, made by the American Broach & Machine Co., Ann Arbor, Mich. Each of the accompanying illustrations shows one of these operations being performed on the part, as well as specimens of the work before and after the operation. A description of each operation and the floor-to-floor time required are given in the following: The first operation on the part is shown in Fig. 1. This operation consists of broaching the rectangular hole shown unfinished at *A* and finished at *B*, the work being shown at *C* with the broach being pulled through it. The time required for this operation is thirty seconds.

The next operation on the wrench part is illustrated in Fig. 2 and consists of broaching slot *B* along the upper side of hole *A*. This slot is provided to accommodate the lower portion of the movable jaw of the wrench when the latter is assembled. The work is again shown in place on the machine at *C*, suitable means being provided for locating the part and holding it in an upright position during the operation. Two broaches are necessary for the production of this slot, and both of them are used in thirty-two seconds. The final broaching operation on the part consists of broaching an angular slot *B*, Fig. 3, through surface *A* of the part. The purpose of this slot is to afford clearance for a reinforced rib on the movable jaw of the wrench. Eighteen seconds is the time required for this operation.

* * *

It is stated that 86 per cent of the automobiles in the world are manufactured in America. Over 80,000 automobiles were exported during the last fiscal year. It is estimated that there are about 7,000,000 or 8,000,000 automobiles in use in the United States at the present time.

Fig. 3. Final Operation which consists of broaching an Angular Slot

NEW AUTOMOBILE WITH AIR-COOLED ENGINE

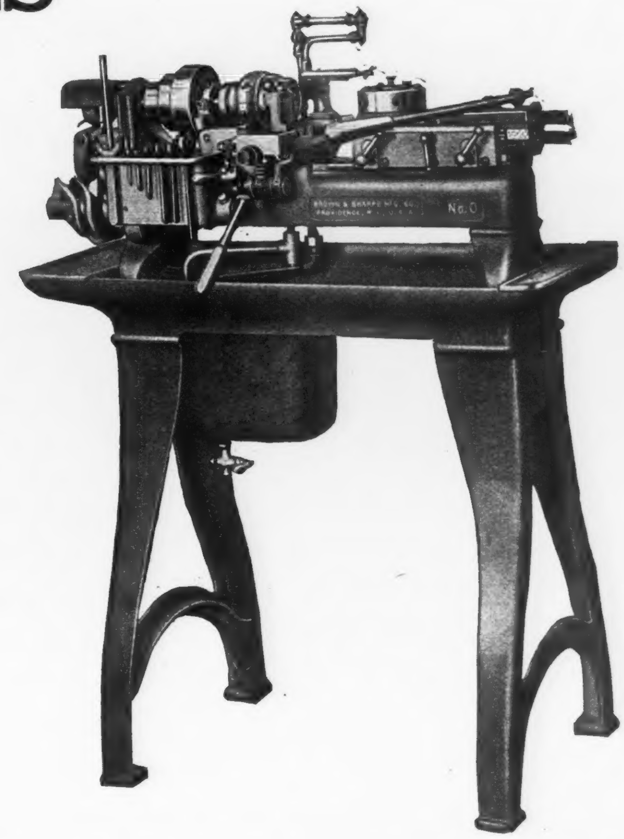
It is reported that a new automobile with an air-cooled type of engine, known as the Spencer, has been developed by the Research Engineering Co., of Dayton, Ohio. According to O. H. Spencer, the inventor of the motor, the new car will be light and high-powered, weighing approximately 1500 pounds and selling for $1200. It is stated that tests have been made of the air-cooled engine in competition with a good water-cooled engine of the same stroke and bore, and that the Spencer motor was run for an hour up to 3500 revolutions per minute without being overheated. A factory is now being planned and the promoters hope soon to be able to produce the car on a commercial scale.

* * *

INDUSTRIAL VALUE OF MOVING PICTURES

The Goodyear Tire & Rubber Co. recently installed a moving picture in one of its plants, mainly with a view to furthering the safety movement. Various methods of accident prevention in other plants were shown. The company asked each employe to submit in writing a brief statement as to his opinion of the value of the pictures to himself and his fellow-workmen. It was found that one of the valuable results derived from the pictures was that it enabled older employes to answer the questions of new men coming into the plant. In addition to Safety First pictures, films were also shown of the work in which the men were engaged and of the processes through which the raw materials had been passed before coming to the plant. This aroused a great deal of interest, and the general conclusion was that the more knowledge a workman can acquire relative to the materials used in his department, the more intelligent work he will be likely to do. That the motion picture will prove of great educational value in the industries is beyond doubt.

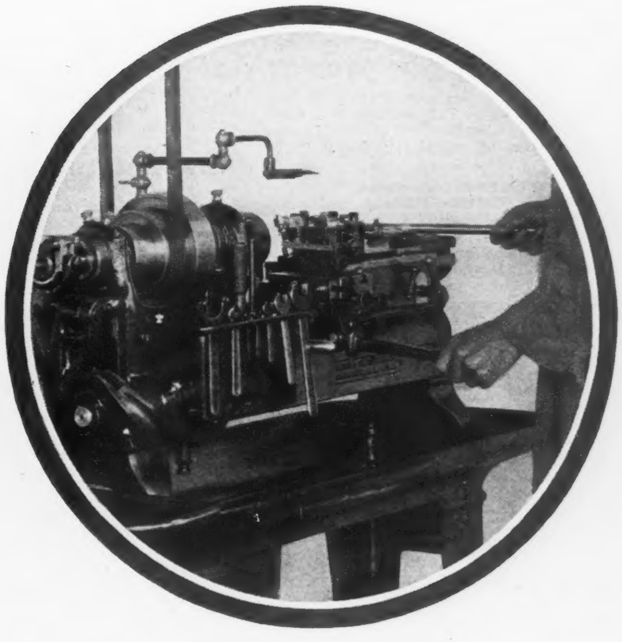
WIRE FEED MACHINES



The ease and rapidity with which the smaller machines are controlled is particularly noteworthy. The operator has complete control of all operations by means of two levers. One advances the turret tools, the other controls the cross slide tools. When the piece is cut off, a slight forward movement of the cross slide automatically trips the feed clutch, bringing the next length of stock into position.

This largely eliminates lost motion, every lever being so located that a minimum amount of labor is involved in operating the machines.

Send for Catalog 22-G



TWO LEVER CONTROL

COMPANY, Providence, Rhode Island, U.S.A.

PERSONALS

P. V. BURWELL has been appointed assistant advertising manager of the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md.

FRANK THORNTON JR., chief engineer of the Westinghouse Electric Products Co., has been appointed manager of the electric heating engineering department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

JOHN T. CHIDSEY, president of the C. J. Root Co., Bristol, Conn., manufacturer of automatic counters, has been elected president of the Chamber of Commerce of Bristol, and a member of the board of directors of the Connecticut Chamber of Commerce.

JOHN C. PANGBORN, vice-president of the Pangborn Corporation, Hagerstown, Md., manufacturer of sand-blasting and allied equipment, sailed November 27 on the *Olympic* from New York for Southhampton, with the intention of spending several months in Europe on business.

GEORGE E. TEMPLE has been appointed manager of the welding and cutting equipment department of the Oxweld Acetylene Co., New York City. Mr. Temple was previously connected with the Prest-O-Lite Co. which formerly manufactured and marketed the welding and cutting apparatus known as "Eveready."

ERNEST C. MORSE, director of sales of the War Department, who retired from service on December 31, has been awarded the Distinguished Service Medal for his work in organizing and training a competent force for supervising, coordinating, and directing the disposal of the vast War Department surplus of supplies. During Mr. Morse's term of office as director of sales, more than $1,750,000,000 worth of supplies were disposed of, at a percentage of recovery of 63 per cent.

HENRY S. MOOS has recently returned to Spain from this country after having made arrangements for the American Machinery Corporation, of Madrid and Sindicato de Maquinaria Americana, of Bilbao, with whom he is associated, to represent a number of American machine tool manufacturers in Spain. Mr. Moos and the engineers associated with him will attend to the inquiries and the engineering needs of the Spanish industry. American machines will be demonstrated in practical operation in the show rooms of the two companies, and important stocks of machines and tools will be carried. These concerns maintain a New York office at 719 Broadway.

GEORGE T. CHAPMAN, who has been connected for the last two years with the Flaxen Fiber Down Co., of North Tonawanda, N. Y., as machine and tool designer, engaged on the development of some new textile machinery, intends to devote his entire time to the development of an automatic gear-shifting device for automobiles. The fundamental principle on which the mechanism is based is that a motor in order to operate at high efficiency should never run, under a load, below a certain number of revolutions per minute; consequently, in ascending a grade the device will shift from high to second, as soon as the engine fails to make the proper number of revolutions, and in the same manner from second to low. The mechanism operates in a similar manner when descending. When a car is brought to a standstill, the gears are automatically shifted to low for starting.

ETHAN VIALL, for the last ten years on the staff of the *American Machinist*, has resigned as editor-in-chief to become a member of the firm of T. W. Minton & Co., Barbourville, Ky., the largest producers of hickory dimension stock in the country. Previous to joining the staff of the *American Machinist*, Mr. Viall was a frequent contributor to numerous technical journals, and was for fourteen years foreman and superintendent in several plants in the Middle West. He made a specialty of automatic machine work and tool and die design, as well as giving considerable study to broaching and welding. He is a member of the American Society of Mechanical Engineers, the Society of Automotive Engineers and the American Institute of Electrical Engineers. He is author of a number of books. Mr. Viall is especially well known among the machine tool men of Cincinnati and the Middle West. He is succeeded by K. H. Condit, formerly managing editor.

OBITUARIES

M. L. ANDREW, president of M. L. Andrew & Co., Cincinnati, Ohio, special machinery manufacturers, died December 9 at the age of eighty-four years. Mr. Andrew was born in Port Credit, Ontario, Canada, and came to the United States when he was fourteen years old. He entered an apprenticeship in a tool shop at Rochester, finishing his trade just before the outbreak of the Civil War. After serving in the Navy as assistant engineer of the United States fleet during the war, he became affiliated with J. A. Fay & Co., in Cincinnati with whom he was associated for twenty years, and then engaged in business for himself as a manufacturer of wood-boring machines. About six years ago he retired from active work because of failing health.

COMING EVENTS

January 11-13—Annual meeting of the Society of Automotive Engineers in New York City. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

January 24-29—Third National Marine Exposition held at Grand Central Palace, New York City, under the auspices of the National Marine League of the United States of America, 268 Pearl St., New York City.

February 1-3—Annual and general professional meeting of the Engineering Institute of Canada in Toronto; headquarters, King Edward Hotel.

April 27-29—Convention of the Society of Industrial Engineers in Milwaukee, Wis. Business Manager, George C. Dent, 327 S. La Salle St., Chicago, Ill.

May 4-7—Eighth convention of the National Foreign Trade Council in Cleveland, Ohio. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 16-18—Joint convention of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association, and the American Supply & Machinery Manufacturers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel.

May 19-20—Spring convention of the National Machine Tool Builders' Association in Atlantic City, N. J.; headquarters, Hotel Traymore. General manager, Charles E. Hildreth, Worcester, Mass.

SOCIETIES, SCHOOLS AND COLLEGES

Northeastern College, Bridgeport, Conn. Catalogue for 1920-1921, containing general information and outlining the courses for the evening school of engineering.

Valparaiso University, Valparaiso, Ind. General catalogue, 1920-1921, containing calendar and general information concerning the university, courses of instruction, etc.

California Institute of Technology (formerly Throop College of Technology), Pasadena, Cal. Annual catalogue for 1919-1920, including a statement of requirements for admission, a description of the courses of instruction, and announcements.

Detroit Institute of Technology, Detroit, Mich. Bulletin of the school of engineering, giving an outline of the mechanical and electrical engineering and trades courses offered. Circular entitled "Learn to Be a Machinist," containing a description of the machine shop courses offered by the institute. Bulletin entitled "Learn Autos where Autos are Made," containing information relating to the automotive school.

NEW BOOKS AND PAMPHLETS

Proceedings of the Annual Convention of the Industrial Relations Association of America. 592 pages, 6 by 9 inches. Published by the Industrial Relations Association of America, Orange, N. J. Price, $5.

Slushing Oils. By Percy H. Walker and Lawrence L. Steele. 23 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 176 of the Bureau of Standards. Price, 5 cents.

Relation of the High-temperature Treatment of High-speed Steel to Secondary Hardening and Red Hardness. By Howard Scott. 16 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 395 of the Bureau of Standards. Price, 10 cents.

A Study of the Relation between the Brinell Hardness and the Grain Size of Annealed Carbon Steels. By Henry S. Rawdon and Emilio Jimeno-Gil. 45 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 397 of the Bureau of Standards. Price, 10 cents.

Advanced Shop Drawing. By Vincent C. George. 147 pages, 6 by 9 inches; 137 illustrations. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $1.60.

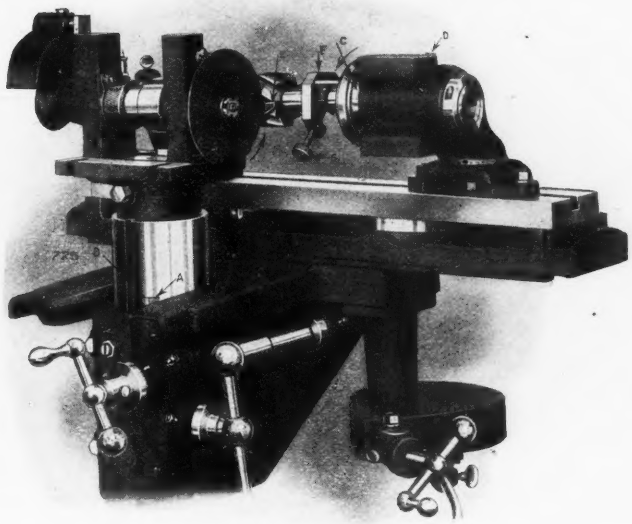
The contents of this book have been laid out with the view of enabling anyone who has had preliminary training in mechanical drawing and in the use of drawing instruments, to gain a practical knowledge of drafting as applied to various lines of engineering. The text material and problems have been so arranged as to enable the student who has had sufficient practice in drawing to become familiar with the principles of orthographic projection and the use of drawing instruments. Emphasis has been laid on drafting as applied to such special subjects as pictorial representation, patent office drawings, electrical drawing, piping lay-outs, structural drawing, and sheet-metal work. An idea of the treatment of the subject will be obtained from a list of the following chapter headings: Working Drawings; Gearing; Gearing (Bevel, Worm, and Special Gears); Isometric, Cabinet, and Shaded Drawings; Patent Office Drawings; Structural Drawing; Electrical Drawing; Plans for Pipe Systems; and Sheet-metal Work.

Safety in the Machine Shop. 188 pages, 6 by 9 inches. Published by the Travelers Insurance Co., Hartford, Conn.

This book has been produced as the result of an effort on the part of the company to reduce the number and severity of industrial accidents. It is divided into fourteen sections, the first of which outlines the development of the modern machine shop from its earliest beginning up to the present-day shop employing thousands of persons. The remaining sections of the book discuss the safety problems that arise in the machine shop, special attention being paid to the hazards responsible for the major part of the serious accidents. The subject matter covers the Use of Cranes; the Spacing of Machines; Shafting and Belting; Individual Motor Drive; the Safe Operation of Lathes; Forging and Hammering; the Press-working of Metals; Automatic Machines; Infection from Cutting Oils; Grinding, Polishing, and Buffing; Hand Tools; Illumination; and the Employment of Women. Those interested in the prevention of accidents in industrial plants will undoubtedly find many valuable suggestions in this book. Copies will be sent without charge upon request to the supply department of the company.

Motorcycles and Side Cars. By Victor W. Page. 693 pages, 5 by 7½ inches; 371 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $3.

This is a new enlarged and revised edition of a book describing the leading types of motorcycles, their design, construction, maintenance, operation, and repair. The new edition incorporates the 1921 improvements in motorcycle construction, and gives complete instructions for starting, driving, and repairing all types of motorcycles. Modern starting methods are dealt with in detail, and an explanation is included of the



Method of setting for clearance

It has been demonstrated that the correct clearance angle to suit the work to be milled, is the most important thing about cutter sharpening. The Cincinnati Clearance Setting Dial is the only device that will produce the correct clearance angle in every-day cutter grinding practice.

The Cincinnati Patented Clearance Setting Dial

Patents Sustained by the Courts

There is a graduated dial on the work head spindle, from which the clearance angle may be read direct. This eliminates the use of tables and formulas. You can always duplicate exactly the correct clearance at repeated grindings.

You avoid the inaccuracy of determining clearance by the old method of measuring vertical adjustment. It is simple to use, and insures accurate results. No other Grinder provides a setting dial. Our patents have been sustained by the Courts. This feature alone gives our machines unusual value over all others.

Grind your cutters the Cincinnati Way and you will get more work, of a better quality from your Millers

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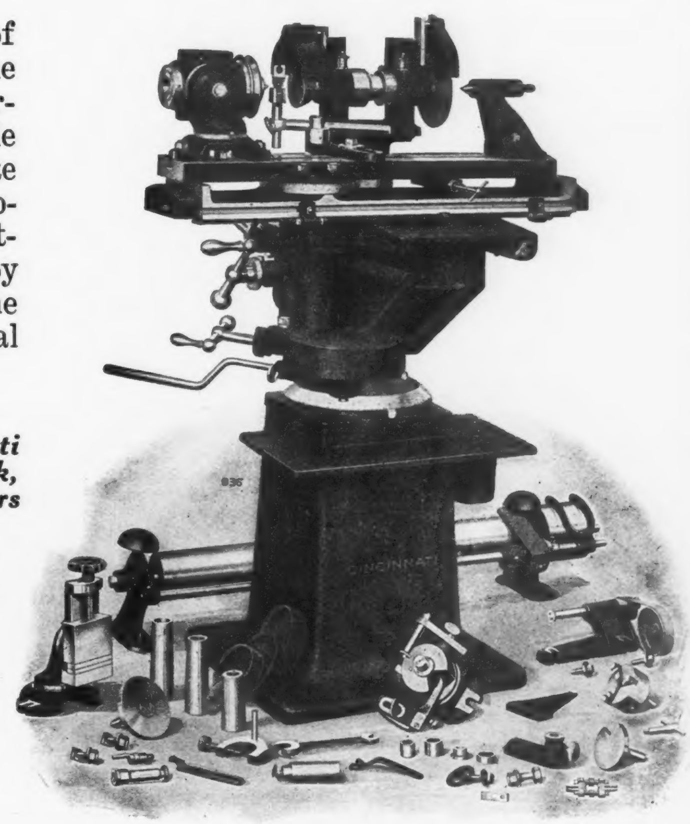

The No. 1½ Cincinnati Universal Cutter and Tool Grinder

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operating principles and repair of the new automatic electric lighting systems. The types of change-speed gears and clutches are described, and instructions for their use are given. A new chapter has been added on the thorough overhauling and repairing of motorcycle engines, and the reader is told how to detect depreciation and make adjustments. The book contains eleven chapters headed as follows: Motorcycle Development and Design; the Motorcycle Power Plant Group; Construction and Design of Engine Parts; Lubrication, Carburetion, and Ignition; Power Transmission System Parts; Design and Construction of Frame Parts; Construction, Equipment, and Operation of Modern Motorcycles; Motorcycle Maintenance; Harley-Davidson-Remy Electric Lighting and Ignition System; Motorcycle Troubles and Side Car Attachment; and Complete Instructions for Overhauling Engine.

Industrial Oil Engineering. By John R. Battle. 1065 pages, 5 by 7½ inches. Published by J. B. Lippincott Co., Philadelphia, Pa. Price, $10.

This is the first part of a reference work which is to be published in two volumes, containing data relating to lubrication and industrial oils, general oil information, and engineering and industrial oil requirements, intended for the use of oil engineers, lubricating engineers, oil salesmen, oil equipment manufacturers, mechanical engineers, machinery designers, mill and power plant superintendents, purchasing agents, and others interested in the selection and utilization of oil products and equipment. The first volume of this work covers the field of lubricating engineering, industrial oils and processes, fatty oils, lubricating and industrial oil equipment, marketing data for oil, specifications, etc. The book is divided into eleven sections as follows: Mathematics; Marketing; Mechanical Engineering; Petroleum and its Products; Fats and Oils other than Petroleum Products; Testing and Properties of Oils; Lubrication and Friction; Filters, Filtration, and Reclamation of Lubricating Oils; Oil Storage and Handling; Industrial Practice and Utilization of Lubricating Oils and Industrial Oils; and Industrial Oil Specifications. The tenth section is subdivided into a number of subsections, each dealing with the utilization of oil products for a specific industrial or manufacturing purpose. Special pages are inserted between each section on industrial practice to provide space for the user to insert prices, tests, and competitive brands for his own oils and other products.

Essentials of Descriptive Geometry. By F. G. Higbee. 218 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $2.25.

This is the third edition of a book on geometry which has been in use in the classroom for some time, and the changes incorporated in the new edition have been suggested by its use. Changes have been made in the data of some of the problems in order to more clearly emphasize certain important points, a number of the illustrations have been improved, and portions of the text have been reworded in such a way as to help students over difficult ground. The aim of the author in writing the text has been to include only those portions of descriptive geometry that possess industrial utility and develop qualities of mind essential in a draftsman. The purpose of the book is first to teach projection; second, to develop the ability in the student to solve problems concerning the relations of points, lines, and planes, which are elementary parts of all engineering structures as shown on drawings; third, to promote the ability to analyze a problem, to reason from a given set of conditions to a required set of conclusions, and to build up from the drawing a mental picture of the object which is presented. Thus it will be seen that the subject has been discussed from the point of view of the draftsman. There are twenty chapters included in the book, which are headed as follows: Orthographic Projection; Profile Plane; Assumption of Points and Lines; Planes; Location of Points, Lines, and Planes; Revolution of Points; Problems on the Line; Problems on the Plane; Problems on Angles; Problems on Points, Lines, and Planes; Surfaces; Plane Surfaces; Cylindrical Surfaces; Conical Surfaces; Intersection of Surfaces; Surfaces of Revolution; Warped Surfaces; Tangent Planes and Lines; Model Making; Appendix.

Labor's Crisis. By Sigmund Mendelsohn. 171 pages, 5 by 7½ inches. Published by the Macmillan Co., 64 Fifth Ave., New York City. Price, $1.50

This book constitutes a discussion of labor problems written from the employer's viewpoint. The author states in the preface that he makes no pretensions to a scientific study of the institution of labor nor of the causes and effect of the present labor unrest. His observations are based on the practical experience of an employer who has to deal not with theory but with the facts that determine the relationship of capital and labor. The book analyzes the labor problem as it exists today and discusses the causes of the present labor unrest, which it is pointed out, is a logical sequel of the conditions under which labor existed until recently. The psychology of labor strongly influences the relation between capital and labor, as well as the performance of labor, and the author believes that mistrust and prejudice can be transformed into good will and confidence when the laborer is made to realize that his own welfare is served and promoted in his employment. The subjects discussed are treated under the following headings: Poverty, its Nature and Effect; Poverty as Related to Labor; Characteristics of Capital and Labor; Labor not a Commodity; Comparative Value of Physical and Mental Exertion; Depletion and Deterioration of Labor; Labor-saving Inventions and Labor Supply; the Malthusian Theory as Applied to Labor; Maximum Effort the Foundation of Society; Economic Effect of Curtailed Labor; Can Reduced Hours Advance the Welfare of Labor and Society? Cost of Living Subject to Psychological Influences; Inflated Cost of Living Due to Contraction of Labor; Labor Welfare as Related to Material and Social Welfare; Causes of the Present Labor Ferment; Profit-sharing as a Basis of Insurance and Pensions; Labor Unrest as a Check upon Industrial Concentration; Moral Economics as Applied to Labor; Handling of Labor in Small Plants; Labor as It Affects the Wife and the Home; Objections to a Legislated Minimum Wage; Housing of the Laborer; Inflation and High Taxes—their Effect.

MacRae's Blue Book. 1851 pages, 8½ by 11½ inches. Published by MacRae's Blue Book Co., Railway Exchange, Chicago, Ill.; New York office, Hudson Terminal Bldg. Price, $10.

This is the 1920 edition of an annual publication intended to serve as a buying guide for the machinery and allied industries. It is divided into the following sections: Catalogue section, address section, classified material section, trade name index, miscellaneous data section, standard list prices of building materials and iron and steel products, and net discount computer. The catalogue section illustrates and gives descriptive matter of the products of the various manufacturers included in the directory, the information being collated in condensed form for ready reference; this section covers 300 pages. The address section, which covers 100 pages, lists in alphabetical order the addresses of all the principal manufacturers of iron and steel products, building materials, etc., in the United States, and gives the location of their branch offices and representatives. The classified material section contains 20,000 classifications, arranged alphabetically, of iron and steel products, building construction materials, railway supplies, etc., the names and addresses of the manufacturers of each class of equipment being given. This material, which comprises the main section of the book, covers 1100 pages. In the trade name index, comprising 100 pages, are given the names of manufacturers of many thousands of trade-named articles. In the miscellaneous data section is collected and indexed information of special interest to the man who specifies or purchases material. It contains 100 pages of tabular matter, including such material as weights and dimensions of steel angles, weights of band iron, approximate weight of leather belting, tables of board measure, weights of seamless brass tubing, tables of weights and thicknesses of cast-iron pipe, weights of pipe fittings, weights and strength of chain, weights of steel disks, engine classifications, dry and liquid measures, standard dimensions of steel rails, wire tables, and a large amount of railway and other data. A distinctive feature of the book is the section giving standard list prices of the products, included in the directory. This section is supplemented by the net discount computer, the two latter sections covering 155 pages.

NEW CATALOGUES AND CIRCULARS

Charles A. Schieren Co., 73 Ferry St., New York City. Calendar for 1921, advertising "Duxbak" leather belting.

Whitman & Barnes Mfg. Co., Akron, Ohio. Calendar for 1921, containing three months on each sheet, and a view of a Whitman & Barnes twist drill and reamer.

Edison Lamp Works of General Electric Co., Harrison, N. J. Buletins LD-117 and 119, treating of the calculation of lighting installation, and the manufacture of the Edison mazda lamp, respectively.

Smalley-General Co., Inc., Bay City, Mich. Circular descriptive of the No. 1B Smalley-General thread milling machine, the No. 1C thread milling machine with power traverse, and the No. 4 thread milling machine.

Warner Elevator Mfg. Co., Cincinnati, Ohio. Circular containing a reprint of a paper on "Passenger Elevator Service," by Howard B. Cook, presented at the Elevator Manufacturers' Association's convention in Atlantic City.

General Electric Co., Schenectady, N. Y. Calendar for 1921, containing on each sheet the current month and the preceding and following months, as well as a view of different electric equipment produced by the company.

Oliver Instrument Co., Adrian, Mich. Circular illustrating the Oliver sawing, filing, and lapping machine, which is adapted for sawing and filing articles from carbon, fiber, bakelite, cardboard, soft or hard rubber, and leather, as well as for metal working.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Leaflet 862, treating of Cutler-Hammer convector type electric air heaters for use in industrial plants and factories for heating crane cabs; valve, pump, and meter houses; exposed remote corners or rooms; and similar uses.

James Clark, Jr., Electric Co., Louisville, Ky. Catalogue 28, containing illustrations, descriptions, and specifications for the "Willey" line of electrically driven tools, including portable drills, screwdrivers, grinders, hacksaws, bench drills and sensitive drilling machines.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular containing information relating to the proper care of punches and dies, discussed under the following heads: Lining up punch and die; lubrication; stripping; loose nuts and stems; hard material; ripping; and multiple work.

Dodge Sales & Engineering Co., Mishawaka, Ind. Catalogue describing Dodge heavy oil stationary engines, heavy oil marine engines, and heavy oil engine electric generating units. Catalogue containing 160 pages, 6 by 9 inches, treating of Dodge standardized elevators and conveyors.

Metalwood Mfg. Co., Detroit, Mich. Bulletins B-18, B-38, and B-68, illustrating, respectively, the Metalwood No. 10 stamping and embossing press; drop-forged steel flange unions for light hydraulic, superheated steam, and ammonia pressures; and heavy hydraulic and steam flanged fittings.

Cooper Hewitt Electric Co., 95 River St., Hoboken, N. J. Technical bulletin 102 on Cooper Hewitt quartz lamp and ultra-violet light. Bulletin 86, descriptive of the Cooper Hewitt quartz lamp laboratory outfit, which is used as a source of ultra-violet light for chemical and industrial purposes.

Precision & Thread Grinder Mfg. Co., Philadelphia, Pa., manufacturer of the multi-graduated precision grinder, announces that additional loose-leaf catalogue pages showing operations of internal thread grinding and the grinding of spindle threads on new and used lathes are now ready for distribution.

Cedar Rapids Engineering Co., Cedar Rapids, Iowa. Circular descriptive of the construction and design of the "Kwik-way" valve facing machine for use in refacing motor valves preparatory to grinding. The machine has a capacity for any size valve up to and including 3-inch head, and ½-inch stem.

Fort Wayne Engineering & Mfg. Co., Fort Wayne, Ind. Bulletin 5011, listing the characteristic features of the "Paul" Type A cold water check valve, for use in suction lines with pressures up to 100 pounds per square inch. A diagrammatic view shows the valve in five different working positions.

Victor R. Browning, Cleveland, Ohio. Bulletin illustrating and describing the various types of electric overhead cranes and hoists manufactured by the company. Tables of specifications for I-beam traveling cranes, geared trolleys and push trolleys, as well as a clearance table for box girder type cranes are included.

Defiance Packless Valve Co., 431 S. Dearborn St., Chicago, Ill. Pamphlet descriptive of the Defiance packless valve, which is designed with a metal-to-metal seat and a non-rising stem to prevent leakage. These valves are applicable for low- and high-pressure steam, hot and cold water, and oil and air up to 2000 pounds.

Pittsburg Steel Stamp Co., Pittsburg, Pa. Catalogue 54, illustrating the line of marking devices made by this company, which includes heavy-duty single letter stamps, steel type holders, hammer and fuller stamps, hand stamps, inspector's hammer, special stamps for marking shells, billets, etc., coining dies, and graduating dies.

Chicago Belting Co., 127 N. Green St., Chicago, Ill. Catalogue of leather packings, cups, valves, and leather specialties. All the standard sizes of packings made by the company are illustrated in the catalogue, but attention is called to the fact that special packings are also provided in any shape or size, and in any number of plies.

Reed Mfg. Co., Erie, Pa. Folder entitled "The Primary Function of a Vise," pointing out the influence that the construction of a vise has on the work performed by its use, and explaining the characteristics necessary in a satisfactory vise. Features of the Reed vises are described, and special attention is called to the rigidity of their construction.

Jaynes Period Counter Co., Inc., 202 Main St., Buffalo, N. Y. Circular descriptive of the operation of the Jaynes period counter—an instrument for obtaining and recording factory costs, which is made in two types, designated as weekly and monthly machines. The circular reproduces cards containing records made on this machine to illustrate its operation.

Yost Mfg. Co., Meadville, Pa. Catalogue 9, containing illustrations and tables of dimensions and prices of the Yost line of vises, including machinists' vises, chipping vises, filers' vises, double-swivel toolmakers' vises, drill press vises, pipe vises, woodworkers' vises, etc. A section of the catalogue is also devoted to the Yost soldering furnaces and anvils.

National Premier Machine Tool Co., 1512 Lakeside Ave., N. E., Cleveland, Ohio. Circular describing the Premier screw-cutting bench and production lathe. The circular shows a general illustration of the lathe, and contains complete specifications, and a description referring in detail to the various parts of the lathe, such as the bed, carriage, tailstock, spindle, etc.

Consolidated Belting Co., Germantown and Sedgley Aves., Philadelphia, Pa. Catalogue 12, treating of "Hycalibre" leather products, and

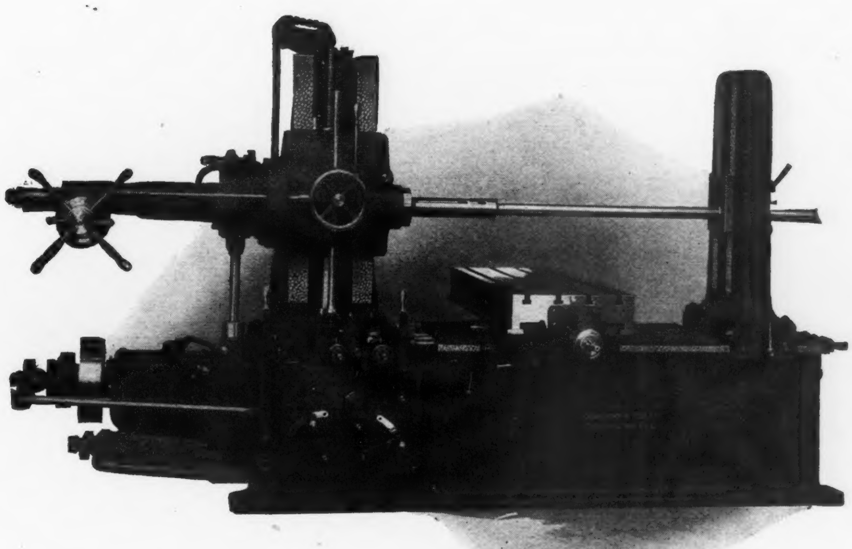
Anyhow, we are not tied down to large JIGS, the cost of which MIGHT hold us back from making the

"PRECISION"

BORING, DRILLING AND

MILLING MACHINE

better, when we saw a way to do so.



The "PRECISION" is a Jig in Itself

and is the kind of big jig we can use in our own factory (and so do many others).

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

containing views of some of the steps in the production of leather belting, as well as suggestions relating to belting problems. Formulas are given for calculating the length, width, horsepower and speed of belts, and for calculating the size and speed of pulleys.

Union Switch & Signal Co., Swissvale, Pa. Catalogue showing the products of the drop-forge department of the company, including axles, crankshafts, radius-rods, connecting-rods, brake-shoes, steering knuckles, gear-cases, levers, etc. The pamphlet also gives a chart of S. A. E. steel specifications for carbon steels, screw stock, steel castings, nickel steels, nickel-chromium steels, chromium steels, chromium-vanadium steels, and silico-manganese steels.

Halcomb Steel Co., Syracuse, N. Y. Card giving the uses and heat-treatment of high-speed and tool steels. On the card are reproduced the labels of various brands of high-speed and tool steels made by this company, and opposite each label are given the principal uses of the steel and the proper temperatures for forging, hardening, and drawing. Only those steels are described that are carried in stock in Syracuse and in the company's branch warehouses.

General Electric Co., Schenectady, N. Y. Bulletin 42010A, illustrating and describing small Curtis steam turbine generating sets which have been used under a great variety of service conditions in stationary plants, for train lighting, and on board ship. These sets have a capacity up to 300 kilowatts. Bulletin 49706, descriptive of the construction and function of the oil conservator for power transformers. The bulletin shows photographs of conservator tanks and of installations of this type that have been made.

Air Reduction Sales Co., 120 Broadway, New York City. Booklet entitled "Cutting Cast Iron with the Oxy-acetylene Torch," containing a reprint of a paper on this subject prepared by A. S. Kinsey, professor of shop practice, Stevens Institute of Technology, for a convention of the American Foundrymen's Association. The article describes how the cut is made, gives the necessary pressures of oxygen and acetylene for varying thicknesses of metal, and describes the advantages to be obtained from the use of the torch for cast iron.

Birmingham Tool & Gage Co., Grove St., Winson Green, Birmingham, England. Catalogue containing illustrations and descriptions of high-speed steel milling cutters and reamers, the dimensions of which conform to the standards laid down by the British Engineering Standards Association. The leaflet gives dimensions of cylindrical cutters, side and face milling cutters, slotting cutters, angle cutters, end-mills, T-slot cutters, form cutters, grooving and fluting cutters, as well as of hand reamers, jig reamers, chucking reamers, taper pin reamers, and bridge reamers.

L. S. Starrett Co., Athol, Mass. General catalogue covering the line of small tools produced by this company. This catalogue contains information about twenty-one new tools, one of the improved tools being a universal bevel protractor. A new micrometer caliper gage is also shown, which is especially adapted to the tire industry for measuring tire molds. A new toolmaker's button intended principally for heavy jig work is also shown. Improved micrometer caliper heads and micrometer caliper sets are included, as well as a new metric fillet or radius gage and an accurate set of V-blocks for use in connection with the surface plate, angle-iron, etc.

Timken Roller Bearing Co., Canton, Ohio. Circular entitled "The Companies Timken Keeps," containing a list of the names of passenger car, commercial car, farm tractor, axle, and transmission manufacturers in America and Europe who use Timken tapered roller bearings, wholly or in part in their present models. The list covers thirty-seven 4- by 7-inch pages. Under the name of each company is given the product in which Timken bearings are used. Booklet containing a record of four interviews which took place between the Tikmen Roller Bearing Co. and a large tractor corporation, in which the latter was convinced of the advantages of applying Timken tapered roller bearing in its product.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 222, describing the car type and the car-and-ball type furnaces, placing before furnace-using manufacturers the principles involved in the design and use of these furnaces. The bulletin points out the applicability of the car type and the car-and-ball type to the heat-treatment of materials that cannot be advantageously handled in other types of furnaces; the factors governing the selection of the type of furnace best suited to individual manufacturing requirements; the differences in the design of the two types mentioned; and the influence of unequal cooling on the quality of the finished product. It also gives examples of typical heat-treatment installations using the car type and the car-and-ball type furnaces.

National Twist Drill & Tool Co., Detroit, Mich. Catalogue 11, containing illustrations and tables giving dimensions and prices of the line of high-speed and carbon steel twist drills, reamers, milling cutters, and special tools made by this company. The book is divided into four sections as follows: Drill section, reamer section, cutter section, and millimeter section, the latter giving millimeter sizes for the different tools. The practice is followed all the way through the book of giving two prices for each tool—one for the tool made from carbon steel, and one for the high-speed steel tool, the latter being printed in red in each case. The high-speed tools are given distinguishing numbers which are also printed in red so that they can be easily picked out. The catalogue concludes with general tabular matter including tables of speeds, decimal equivalents, weights of carbon and high-speed steel bars, tap drill sizes, etc.

Federation of British Industries, 4 Red Lion Court, Fleet St., London, E. C. 4, England. Export Register of the Federation of British Industries, containing an outline of the organization of the federation and a list of its members, which are classified both alphabetically and according to their products. As the federation comprises no less than 1300 members and is in direct touch with 20,000 British manufacturers covering every industry in the country, the book is virtually a directory. The list of products of the various manufacturers is arranged alphabetically, as is also the list of firm names and agents. There is, in addition, a list of associations arranged alphabetically under the Industrial Grouping System adopted by the federation. With each association are given the names of its exporting members. The book is intended to be of service not only to British merchants and buyers, but to all those who use and buy British goods throughout the world. It is also published in several foreign languages, including French, Spanish, Portuguese, and Dutch.

Cleveland Twist Drill Co., Cleveland, Ohio. Booklet entitled "Handbook for Drillers," which is written for the purpose of making the twist drill clear to even the non-technical reader. The first chapter describes in detail the parts of a twist drill. In the second chapter, which deals with points on grinding, the importance of grinding a drill to produce the correct lip clearance, the proper length and angle of lips, and the correct location of the point in relation to the center of the drill is emphasized. The third chapter treats of drill speeds and feeds. The fourth chapter discusses the drilling of hard material, small-hole drilling, the drilling of brass, cutting compounds for various metals, drilling with automatic machines under flood of lubricant, and thinning the point of the drill. The final chapter deals with common errors and their results, giving reasons for drill breakage and dulling of the cutting edges. The last page of the pamphlet, which is entitled "The Little Doctor" gives a list of symptoms, probable causes, and remedies for drilling machine trouble.

National Tube Co., Pittsburg, Pa. Bulletin 6D, containing an article treating of correct pipe threading principles. The design of threading dies is taken up, information being given on lip angle, chip space, clearance, lead, use of oil, and number of chasers. The care and repair of dies also is discussed at length. The booklet is illustrated with a large number of diagrams as well as halftone illustrations to clarify the points discussed. It contains considerable technical information on the subject, including formulas and tabular matter. Bulletin 7, treating of the manufacture and advantages of National welding-scale free pipe. A detailed description of the process of manufacture is included with illustrations of the various steps, and the physical properties and other qualities of National pipe are discussed. A diagram shows comparative friction velocity curves of standard wrought-iron pipe, and welding-scale free pipe. Bulletin 9, discussing the use of National pipe for shipbuilding purposes. The ductility, uniformity, and other physical properties of National pipe are considered, and tables of properties of pipe, discharging capacities, dimensions of pipe columns, etc., are included.

TRADE NOTES

Wicaco Screw & Machine Works, Inc., has removed its manufacturing plant and general offices to larger quarters at Stenton Ave. and Louden St., Philadelphia, Pa.

Jacquet Motor Corporation of America, Belding, Mich., at a recent meeting of the stockholders voted to increase the capital stock of the corporation from $100,000 to $250,000.

Peninsular Machinery Co., 419 E. Jefferson St., Detroit, Mich., is now occupying its entire building, where a fine display room is maintained. The company reports business very good in both new and second-hand tools.

F. C. Sanford Mfg. Co., 2060 Fairfield Ave., Bridgeport, Conn., announces that in the future the sale of the Sanford precision centerless cylindrical grinder will be handled directly by the company from the home office.

Oxweld Acetylene Co., Carbide and Carbon Bldg., New York City, has appointed the **Standard Supply & Equipment Co.** of New York and Philadelphia, as eastern sales agent for welding and cutting apparatus known as "Eveready."

G. C. Goode Co., production engineers, have opened an office at 317 Frankfort Ave., Cleveland, Ohio, to distribute the following lines: Edgar Allen high-speed and carbon tool steels; Davidsonized milling cutters; Lincoln twist drills, reamers and slitting saws; insert blades and quick-change drill chucks.

Precision & Thread Grinder Mfg. Co., Philadelphia, Pa., manufacturer of the multi-graduated precision grinder, has moved its offices from 1932 Arch St. to 1 S. 21st St. A machinery display department will be maintained at the new location, in which will be shown, in addition to the grinders, the Craley master toolmaker, Miller radius and angle wheel dressers, Herrmann snap thread gages, and other tools and accessories.

Air Reduction Sales Co., 120 Broadway, New York City, has recently completed the construction of a four-story addition to its apparatus plant in Jersey City, which will provide for increased production of the "Airco" welding and cutting torches. The extension is of brick with reinforced concrete floors. Careful attention has been paid to securing maximum lighting, and in every other way the comfort and safety of the employes has been considered.

Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., manufacturer of portable electric tools, electric air compressors, and special machinery, has established a new branch office at 303 Penn Ave., Pittsburg, Pa. This office will be the headquarters for the Black & Decker sales force in western New York, western Pennsylvania, and the northwestern part of West Virginia. W. D. Royer, formerly sales engineer of the Robbins Electric Co. of Pittsburg, will be in charge of the new office. A service station has also been established at the same address, where there will be a factory trained mechanic to offer service to users of Black & Decker products in that territory.

Sleeper & Hartley, Inc., 335 Chandler St., Worcester, Mass., designers and builders of high-speed automatic wire coiling machinery and other special machinery, announce that they have decided on a price reduction of 10 per cent upon all their various lines of special and standard machinery, applying to all new business and to take effect immediately. It is stated by Sleeper & Hartley, Inc., that this action has been taken in spite of the fact that there is no reason to believe that there will be any immediate reduction in the cost of labor or in the prices of raw materials; it is their belief that prices in general are too high and must be reduced and the sooner this is done the better it will be for industry.

C. W. Couch & Co. is a new selling organization organized by C. W. Couch, until recently sales manager of the Ford-Clark Co. Previous to his connection with the Ford-Clark Co., Mr. Couch was associated for eleven years with the Western Automatic Machine Screw Co., of Elyria, Ohio. The headquarters of the new company are at 614 National City Bldg., Cleveland, Ohio. Among the firms for whom the organization will act as direct selling agent are the Perry-Fay Co. of Elyria, manufacturer of screw machine products; the City Brass Foundry Co., of Cleveland, manufacturer of aluminum, brass, and bronze castings; the Superior Metal Products Co., of Elyria, manufacturer of pressed and drawn steel parts; and the Marquette Metal Products Co., of Cleveland, manufacturer of hardened and ground steel bushings.

Toledo Crane Co., Bucyrus, Ohio, has been chartered under the laws of the state of Ohio, with a capitalization of $500,000, to succeed the **Toledo Bridge & Crane Co.** of Toledo, Ohio, as manufacturer of Toledo cranes. The new company has purchased all the drawings, patterns, records and other items pertaining to the crane business, and the change will be made without interrupting production. W. F. Billingsley, who for the last eleven years has been active in the management of the crane department for the Toledo Bridge & Crane Co., will hold an executive position with the new company, and the entire crane department organization of the former company will be retained. The plant of the Toledo Crane Co. will consist of a machine shop, 60 by 300 feet, a structural or girder shop, 90 by 300 feet, an assembly shop, 120 by 320 feet, a pattern shop and storage, 75 by 200 feet, and a forge shop, 40 by 100 feet.

Bertschy Engineering Co., Cedar Rapids, Iowa, which was organized in May, 1920, has just completed the installation of a large amount of machine tool equipment. The company started business in July, 1920, when it purchased the buildings, property, and equipment of the Peerless V-Belt Co., of Cedar Rapids. Following its organization in July, it purchased from the Mattison Machine Works, of Rockford, Ill., the metal-working shaper business which had been conducted by the Rockford company for several years. In addition to the purchase of this business, the company also purchased the "Bermo" welding apparatus business from the Bertschy Mfg. & Engineering Co., of Omaha, Neb. Attention is called to the fact that the latter company has no connection with the Bertschy Engineering Co., except for the fact that some of the officers and directors of the Iowa company are interested in the Omaha company. The new Iowa company began its production activities in October, 1920, and now has on hand castings, parts, and material in process of manufacture for 16-, 20-, and 24-inch heavy-duty back-geared shapers. Preparations are being made to extend the machine tool department to take care of the increasing business. In the company's welding apparatus department it has in process of manufacture upward of 5000 complete welding equipments, and a large number of additional "Bermo" welding torches. The company reports that the demand in its belt department exceeds its ability to supply.